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PHILIPS

Service Information

Advanced Automation Systems
Audio-communications
Broadcast Equipment
Electronic Security & Recording Systems
Industrial Automation
Scientific & Analytical Equipment
Test and Measurement

Industrial & Electro-acoustic Systems Division

861101 TEST AND MEASURING EQUIPMENT ESU3055S1.1.

SUPPLEMENT TO SERVICE MANUAL PM 3055 4822 872 05311

This ESU replaces: -

Contents : 1. Erratum

2. Performance check

3. Options

4. Modifications

ATTENTION: Service manual PM3055 - 4822 872 05311 can also be used for the PM3057 oscilloscope.

4822 872 09351
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1. ERRATUM TO SERVICE MANUAL

* Page 2-7
  The correct specification for Delay Time Jitter must be:
  1 : >20000

* Page 2-11
  The correct specification for Power consumption must be:
  Power consumption 45 W.

* Page 4-5
  The correct reference number for OQ 0203 must be: D1061

* Page 5-9
  The connection of R2393 and R2396 must be connected to -17A

* Page 6-4
  The correct reference number for R3051, between V3014 and Y2-plate of the CRT must be R3052.

* Page 6-6
  The correct type indication for V3251 must be BF423.
  The correct reference number for R3252, between potentiometer R3252 and the cathode lead must be R3253.

* Page 7-18
  Diodes V4806-V4807 must be drawn reversed.

* Page 9-1
  The mains voltage is primary protected by a fuse of 1,6 AT

* Page 13-5
  The correct indication near adjusting elements R4108 and R4207 must be 1 ms.

* The correct indication near adjusting element R1164 must be OFFSET x1
  The correct indication near adjusting element R1172 must be OFFSET x10
  The itemnumbering and indication of R3036 and R3038 must be interchanged

* Page 16-1
  Some new codenumbers for mechanical parts are:

Item	Qty	Ordering code	Description
-	3	5322 401 10954	Delay line cable clamp
-	2	5322 255 40054	Heatsink for V3011 and V3012

* Page 16-7
  The codenumbers for the cable connectors are:

10 pole cable connector	X4016-X5007-X6007	5322 268 40234
20 pole cable connector	X2010-X3002-X3003-X4002-X4010-X6009	5322 268 40235
26 pole cable connector	X1009-X2009	5322 267 70175
34 pole cable connector	X2001-X4001-X7001	5322 268 40236

The following AMP connectors are available:

2 pole-single, without contact pins	5322 268 40232
3 pole-single, without contact pins	5322 268 40233
bus contact for AMP-cable connector, per piece:	5322 268 20152
5 pole connector for power-in	5322 267 50452
bus contact for connector, per piece:	5322 268 24128

* Page 16-36
The codenumber for V6021-BZX79-C3V0 is: 4822 130 31881

* Page 16-37
New codenumbers for integrated circuits:

Posnr.	Description	Ordering code
D1061	OQ 0203	5322 209 70392
D1161	OQ 0203	5322 209 70392
D2002	OQ 0205	5322 209 70393
D2102	OQ 0205	5322 209 70393
D2301	OQ 0205	5322 209 70393
D2304	OQ 0128	5322 209 82925
D4103	OQ 0201	5322 209 70391
D7001	8052 AH	5322 209 11349
D7004	OQ 0044	5322 209 11008

* Page 16-39
The codenumber for S6001-POWER ON switch-is:
5322 276 11859

2. PERFORMANCE CHECK

The following chapter contains the complete description of the performance check of PM3055. It can be filed under chapter 11 of the Service manual.

2.1 GENERAL INFORMATION

WARNING: Before switching-on, ensure that the instrument has been installed in accordance with the Installation Instructions outlined in Section 2 of the Operating Manual.

This procedure is intended to:
- Check the instruments' specification.
- Be used for incoming inspection to determine the acceptability of newly purchased instruments and/or recently recalibrated instrument.
- Check the necessity of recalibration after the specified recalibration intervals.

Note: The procedure does not check every facet of the instruments calibration; rather, it is concerned primarily with those parts of the instrument which are essential to measurement accuracy and correct operation. Removing the instruments covers is not necessary to perform this procedure. All checks are made from the outside of the instrument.

If the test is started within a short period after switching-on, bear in mind that steps may be out of specification, due to insufficient warming-up time.
Warming-up time under average conditions is 30 minutes.

The performance checks are made with a stable, well-focussed, low-intensity display. Unless otherwise noted, adjust the intensity and trigger-level controls as needed.

IMPORTANT:
NOTES * At the start of every check, the controls always occupy the preliminary settings AUTO SET position, unless otherwise stated.

* The input voltage has to be supplied to the A-input; unless otherwise stated.
  Set the TIME/DIV switches to a suitable position; unless otherwise stated.

* Tolerances given are for the instrument under test and do not include test equipment error.

* In this chapter in some checks channel B is mentioned between brackets behind channel A. It is advised to perform first channel A checks. After that the checks for channel B can be done.

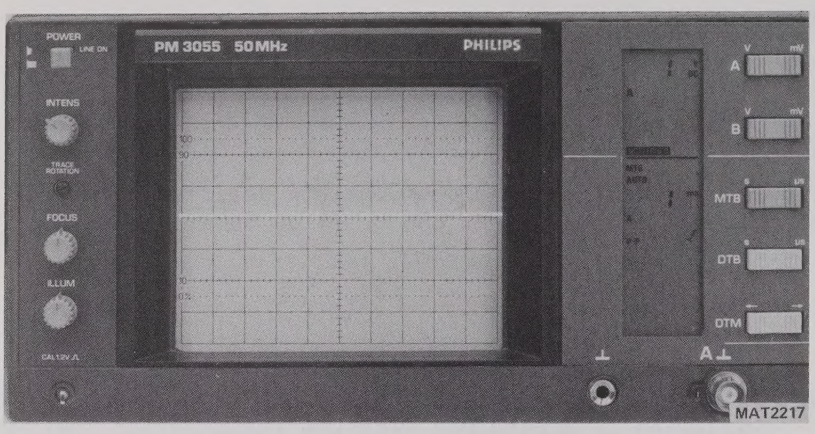

fig. 2.1 RESTART condition

2.2 PRELIMINARY SETTINGS

- Switch-on the instrument (no input signal).
- Check if all LCD segments are on for approx. 1 sec.
- Press MENU and AUTO SET.
- Check if the frontcontrols are set in sequence in the restart condition as indicated in fig. 2.1.
- At the start of every check only AUTO SET must be pressed (after the input signal is applied).

2.3 RECOMMENDED TEST EQUIPMENT

The test equipment that must be used for this performance check is as given in section 13.2 of the Service manual, except:

Trimming tool kit
Oscilloscope
Digital multimeter

2.4 CHECKING PROCEDURE

2.4.1 POWER SUPPLY (characteristics: 2.5)

*	SUBJECT	Line voltage input
	TEST EQUIPMENT	Variable mains transformer
	MAINS VOLTAGE	Between 100 V and 240 V ac (r.m.s.) Frequency: 50 Hz...400 Hz
	SETTINGS	- Press POWER ON - Apply CAL signal to input A - Press AUTO SET
	REQUIREMENTS	- Starts at any mains voltage between 100 V...264 V ac (r.m.s.) - Instruments performance does not change over indicated mains voltage range; displayed CAL signal distortion-free and with equal intensity.
	MEASURING RESULTS	

*	SUBJECT	Power Consumption (ac source)
	TEST EQUIPMENT	Wattmeter (moving iron meter)
	MAINS VOLTAGE	Mains voltage 220 V (r.m.s.).
	SETTINGS	Press POWER ON
	REQUIREMENTS	Consumes : 45 W
	MEASURING RESULTS	

2.4.2 DISPLAY (characteristics section 2.1)

*	SUBJECT	Illumination
	TEST EQUIPMENT	-
	INPUT VOLTAGE	-

	SETTINGS	Operate ILLUM control (fully clockwise)
	REQUIREMENTS	- Check if the graticule raster is equaly illuminated and if the intensity can be controlled continuously.
	MEASURING RESULTS	

---

*	SUBJECT	Trace Rotation
	TEST EQUIPMENT	-
	INPUT VOLTAGE	-
	SETTINGS	- Operate screwdriver adjustment: TRACE ROT
	REQUIREMENTS	Trace must be in parallel with the horizontal graticule line. Direction of screwdriver rotation same as direction of trace rotation.
	MEASURING RESULTS	

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*	SUBJECT	Orthogonality
	TEST EQUIPMENT	LF sine-wave generator
	INPUT VOLTAGE	Sine-wave signal 50 Hz...60 Hz
	SETTINGS	- Set trace exactly in parallel with horizontal graticule line (see section: Trace rotation) - Apply a sine wave signal to input A. (50 Hz...60 Hz) - Set trace height to 8 div. - Press X DEFL. - Press TRIG or X SOURCE and select B as MTB trigger source
	REQUIREMENTS	- Check if vertical line is in parallel with the vertical graticule line in the centre of the screen. - Angle with respect to horizontal line must be 90^{o} +or- 1^{o}
	MEASURING RESULTS	

*	SUBJECT	LCD check
	TEST EQUIPMENT	-
	INPUT VOLTAGE	-
	SETTINGS	- Press MENU and keep it pressed - Then press AUTO SET - Check if LCD indicates "1°", "2°" and "3°" - Press "S" of DTB UP-DOWN control - Press MENU, 8 times - To leave this test: press MENU and then AUTO SET
	REQUIREMENTS	- Check if all segments of the LCD are on (see fig. 3.2 of the Operating manual)
	MEASURING RESULTS	

2.4.3 VERTICAL DEFLECTION OR Y-AXIS (characteristics section 2.2)

*	SUBJECT	Vertical Deflection
	TEST EQUIPMENT	LF Square wave generator
	INPUT VOLTAGE	Square wave signal 1 kHz to A
	SETTINGS AND REQUIREMENTS	- Set trace height to 5 div. - Check if one square wave signal of 5 div. is displayed. - Press A/B; channel A and B on - Check if a square wave signal (A) and line (B) is displayed and if A and B are on. - Press ALT/CHOP - Check if ALT or CHOP is active. - Press TRIG VIEW. - Check if two square wave signals (A and TRIG VIEW) and a line (B) are displayed - Press TRIG VIEW; Check if A and B are on.
	INPUT VOLTAGE	Square wave signal 1 kHz to input A and B

SETTINGS AND REQUIREMENTS
- Press AUTO SET
- Check if A, B and ALT are on
- Set trace height to 4 div.
- Press AC/DC of channel A and B for DC input coupling
- Press ADD/INVERT twice for ADD mode.
- Check if 3 square wave signals are displayed: channels A and B each 4 div. trace height and A+B with 8 div. trace height.
- Press ADD/INVERT once more for ADD and INVERT mode
- Check if 2 square waves of 4 div. (A and B) and a line is displayed (A-B)

MEASURING RESULTS

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* SUBJECT — Vertical Deflection coefficients and input coupling of Channels A and B (characteristics section 2.2.1)

TEST EQUIPMENT — Square-wave calibration generator (PG506)

INPUT VOLTAGE — Square-wave signal 1 kHz to input A(B), amplitude 10 mVpp...20 Vpp in 1-2-5 steps

SETTINGS AND REQUIREMENTS
- Apply a 1 kHz square wave signal of 5 mV to input A(B)
- Set A (B) to 2 mV/div.
- Check if the amplitude of the signal is 5 div. (+or- 3%)
- Increase the input amplitude and vertical sensitivity with the following steps:

Input voltage (pp)	A (B) setting	Requirements	Measuring results
10 mV	2 mV	5 div.(+or-3%)	
20 mV	5 mV	4 div.(+or-3%)	
50 mV	10 mV	5 div.(+or-3%)	
0,1 V	20 mV	5 div.(+or-3%)	
0,2 V	50 mV	4 div.(+or-3%)	
0,5 V	100 mV	5 div.(+or-3%)	
1 V	200 mV	5 div.(+or-3%)	
2 V	500 mV	4 div.(+or-3%)	
5 V	1 V	5 div.(+or-3%)	
10 V	2 V	5 div.(+or-3%)	
20 V	5 V	4 div.(+or-3%)	
50 V	10 V	5 div.(+or-3%)	

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*	SUBJECT	Variable gain control range (continued procedure of previous subject)
	SETTING	- Turn VAR control fully anti-clockwise
	REQUIREMENTS	- Check if displayed amplitude <2 div. (1:>2,5)
	MEASURING RESULTS	

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*	SUBJECT	Input coupling (continued procedure of previous subject)
	SETTINGS AND REQUIREMENTS	- Turn VAR control fully clockwise. - Press "0"; check if input signal is interrupted. - Press "0" again and then AC/DC - Check if in DC position the signal shifts upwards
	MEASURING RESULTS	

---

*	SUBJECT	Input impedance and capacitance
	TEST EQUIPMENT	Calibrated square-wave signal 1 kHz (PG506) via input dummy to input A(B). Dummy for input: 1 Mohm resistor in parallel with a capacitor of 20 pF.
		<u>1 Mohm Input impedance</u>
	INPUT VOLTAGE	Square-wave signal 1 kHz to input A(B) via dummy,amplitude 20 mVpp...100 Vpp in 1-2-5 steps
	SETTINGS AND REQUIREMENTS	- Apply calibrated square-wave signal of 20 mV via dummy to input A(B) - Check the amplitude of the displayed signals according the table below:

Input voltage (pp) via dummy	A(B) setting	Requirements	Measuring results
20 mV	2 mV	5 div.(+or-2%)	
50 mV	5 mV	5 div.(+or-2%)	
0,1 V	10 mV	5 div.(+or-2%)	
0,2 V	20 mV	5 div.(+or-2%)	
0,5 V	50 mV	5 div.(+or-2%)	
1 V	100 mV	5 div.(+or-2%)	
2 V	200 mV	5 div.(+or-2%)	
5 V	500 V	5 div.(+or-2%)	
10 V	1 V	5 div.(+or-2%)	
20 V	2 V	5 div.(+or-2%)	
50 V	5 V	5 div.(+or-2%)	
100 V	10 V	5 div.(+or-2%)	

- Remove input signal.

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* SUBJECT — Frequency response

TEST EQUIPMENT — Constant amplitude sine-wave generator (SG503)

INPUT VOLTAGE — Constant amplitude sine-wave signal, 120 mV frequency 50 kHz...50 MHz to input A (B).

SETTINGS AND REQUIREMENTS

- Set A (B) to 20 mV/div.
- Apply 50 kHz sine-wave signal to A (B)
- Adjust trace height to exactly 6 div.
- Increase the frequency of the input signal up to 50 MHz.
- Check if the vertical deflection is $\geq$ 4,2 div. (-3 dB) over the complete bandwidth range (>50 MHz).
- Reduce the amplitude of the input signal to 12 mV and the frequency to 50 kHz.
- Set A (B) to 2 mV.
- Adjust the trace height to exactly 6 div.
- Increase the frequency up to 35 MHz.
- Check if the vertical deflection is $\geq$ 4,2 div. (-3 dB) over the complete bandwidth range (>35 MHz)

MEASURING RESULTS

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* SUBJECT — Rise-Time

IMPORTANT — THE RISE TIME IS A CALCULATED VALUE, ACCORDING FORMULA: BANDWIDTH X RISE-TIME = 0,35

TEST EQUIPMENT — Fast-rise square-wave generator (PG506)

INPUT VOLTAGE — Fast-rise square-wave signal $\leq$ 1 ns to input A (B) frequency: 1MHz.

SETTINGS
- Set A(B) to 50 mV/div
- Press TB MAGN
- Set MAIN TB to 5 ns/div
- Adjust the trace height exactly between the dotted lines 0% and 100% (5 div.)

REQUIREMENTS — Important: $T_R(\text{measured}) = \sqrt{T_R(\text{input signal})^2 + T_R(\text{oscilloscope})^2}$

- Check the rise-time, measured between the 10% and 90% lines (4 div.);

* rise-time must be: 7 ns or less (1,4 subdiv. or less).

MEASURING RESULTS

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* SUBJECT — Pulse response

TEST EQUIPMENT — Fast-rise square-wave generator (PG506)

INPUT VOLTAGE — Fast-rise square-wave signal ($\leq$ 1 ns) to input A (B)

SETTINGS AND REQUIREMENTS

Note: Take the pulse distortion of the calibration generator (2%) into account when performing the now following calibration steps. The pulse response of the signal at the output of the generator is optimal with max. pulse amplitude.

- The required fast rise-time square-wave must be obtained from the square-wave generator.
- Adjust channel A (B) to an input sensitivity of 20 mV/div.
- Select DC input coupling for channel A (B)
- Apply a 1 MHz/5 div. (+ and - 2,5 div) square-wave signal with a rise-time of 1 ns to input A (B)
- Set the MAIN TB to 50 ns/div.
- Press TB MAGN on.

		- Check the pulse response; * Overshoot, ringing and rounding: <1,5 subdiv. p-p * Duration of ringing: 20 ns (ringing must be ended when amplitude is 1/3 of starting amplitude * Hole or bump: <0,7 subdiv (peak) * Drop or tilt: <0,7 subdiv (peak)
	MEASURING RESULTS	

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*	SUBJECT	Noise
	TEST EQUIPMENT	-
	INPUT VOLTAGE	-
	SETTINGS	- Set channel A and B to 20 mV/div - Press A/B: channel A and B on - Press ALT/CHOP for CHOP mode - Press AC/DC of both channels for DC input coupling
	REQUIREMENT	- Check if the traces are not thicker than 0,5 subdiv.
	MEASURING RESULTS	

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*	SUBJECT	Vertical Dynamic range
	TEST EQUIPMENT	Constant amplitude sine-wave generator
	INPUT VOLTAGE	Sine-wave signal of 10 MHz, 2,4 Vpp to input A(B)

SETTINGS	- Apply sine-wave signal of 10 MHz, 2,4 Vpp to input A(B). - Set A (B) to 100 mV/div. - Shift with the Y POS control the sine-wave vertically over the screen.
REQUIREMENT	- Check if the top and bottom of the sine-wave signal can be displayed distortion-free (24 div. trace height).
INPUT VOLTAGE	Sine-wave signal of 50 MHz, 1,6 Vpp to input A(B)
SETTINGS	- Set A (B) to 200 mV/div. - Set the trace height to exactly 8 div. - Increase the frequency of the input signal up to 50 MHz
REQUIREMENT	- Check if a sine-wave signal of 8 div. is displayed distortion-free.
MEASURING RESULTS	

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*	SUBJECT	Position range (vertical)
	TEST EQUIPMENT	LF Sine-wave generator
	INPUT VOLTAGE	Sine-wave signal of 1 kHz, 8 V to input A(B)
	SETTINGS	- Adjust the channel A (B) input sensitivity to 1 V/div. - Apply a sine-wave of 1 kHz/8 div. to the channel A (B) input. - Adjust the channel A (B) input sensitivity to 500 mV/div. - Rotate the channel A (B) Y POS control fully clockwise and anti-clockwise
	REQUIREMENT	- Check if the top and the bottom of the signal can be positioned on the vertical centre line of the screen.
	MEASURING RESULTS	

---

*	SUBJECT	Decoupling factor between channels A and B at 10 MHz
	TEST EQUIPMENT	Sine-wave calibration generator (SG503)
	INPUT VOLTAGE	Sine-wave signal 10 MHz, 4 V to input A(B)
	SETTINGS	- Set channel A and B to 0,5 V/div. - Apply sine-wave input signal to input A(B) - Press AUTO SET - Set the trace height to 8 div. - Press A/B (channel with input signal off).
	REQUIREMENTS	- Check if trace height of channel without input signal B(A) is < 0,08 div. (1:>100)
	MEASURING RESULTS	

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*	SUBJECT	Decoupling factor between channels A and B at 50 MHz
	TEST EQUIPMENT	HF sine-wave generator (SG503)
	INPUT VOLTAGE	50 MHz sine-wave signal, 4 V to input A(B)
	SETTINGS	- Do the same settings as indicated above
	REQUIREMENTS	- Check if trace height of channel without input signal B(A) is <1,6 div. (1:>50)
	MEASURING RESULTS	

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*	SUBJECT	Common Mode Rejection Ratio
	TEST EQUIPMENT	HF constant Amplitude sine-wave generator (SG503)
	INPUT VOLTAGE	Sine wave signal 1 MHz, 4 Vpp to inputs A and B
	SETTINGS	- Set A and B to 500 mV/div. (8 div.) - Set input coupling of channels A and B to DC - Adjust the VAR controls for minimum trace height difference of channel A and B - Press ADD/INVERT three times (ADD and INVERT on)

REQUIREMENT	- Check if the trace height of the A-B signal is < 0,08 div.
MEASURING RESULTS	

---

*	SUBJECT	LF linearity (vertical)
	TEST EQUIPMENT	LF square-wave generator
	INPUT VOLTAGE	Square-wave signal 50 kHz, 200 mV to input A(B)
	SETTINGS	- Set A (B) to 100 mV/div. - Set the square-wave signal in the vertical centre of the screen. - Adjust the square-wave signal to exactly 2 div. trace height. - Shift the signal with the Y POS control to the two upper and lower div. of the screen.
	REQUIREMENT	- Check if the trace height in the two upper and lower div. is 2 div. (max. ampl. deviation must be <3%)
	MEASURING RESULTS	

---

*	SUBJECT	Visual Signal Delay
	TEST EQUIPMENT	Square wave calibration generator (PG506)
	INPUT VOLTAGE	Fast-rise input signal 1 MHz, $\leq$1 ns, 0,5 V to input A
	SETTINGS	- Apply fast-rise input signal to input A - Press AUTO SET - Set A to 100 mV/div. - Set MAIN TB to 50 ns/div. - Press TB MAGN and turn X POS - Set INTENSITY fully clock-wise
	REQUIREMENT	- Check if visual signal delay is >15 ns
	MEASURING RESULTS	

*	SUBJECT	Base line jump
	TEST EQUIPMENT	-
	INPUT VOLTAGE	-
	SETTINGS	Attenuator balance

- This check must be done in the SERVICE MENU "1". To enter this menu proceed as follows:
- Press MENU and keep it pressed and then press AUTO SET
- Press V of channel A UP-DOWN control
- Check LCD display: "1.0" flashing
- The attenuator is now switched between the 1-2-5 positions
- Check if the base line do not jump more than 1,5 subdiv.

VAR balance

- Press MENU; "1.1" flashing in LCD
- Rotate VAR control of channel A and B
- Check if the base lines do not jump more than 1 subdiv.

X1/X10 attenuator offset

- Press MENU; "1.2" flashing in LCD
- Check if the base lines do not jump more than 1 subdiv.

NORMAL-INVERT jump

- Press MENU four times; "1.6" flashing in LCD
- Check if the displayed point does not jump more than 1 subdiv.
- Press AUTO SET two times to leave the SERVICE MENU

MEASURING RESULTS

2.4.4 TRIGGER VIEW (characteristics section 2.2.2)

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*	SUBJECT	Deflection coefficient via A, B and EXT.
	TEST EQUIPMENT	Square-wave calibration generator (PG506)
	INPUT SIGNAL	Square-wave signal 1 kHz, amplitude given in table.

TRIG VIEW via A(B)

SETTINGS	- Apply the square-wave signal to input A(B) - Press TRIG VIEW (TRIG VIEW and A(B) on) - Select A(B) as MTB trigger source - Select DC for MTB trigger coupling
REQUIREMENT	- Check the amplitude of the TRIG VIEW signal according the table given in section 3.2 of this performance check. IMPORTANT: the error limit of the amplitudes displayed via TRIG VIEW is <5%!!
MEASURING RESULTS	

TRIG VIEW via EXT

INPUT SIGNAL	Square-wave signal 1 kHz, 500 mV to input MTB TRIG or X DEFL.
SETTINGS	- Select EXT as MTB trigger source.
REQUIREMENT	- Check if the square-wave signal displayed via TRIG VIEW has an amplitude of 5 div. (+or- <5%)
MEASURING RESULTS	

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*	SUBJECT	Frequency response INT and EXT (TRIGGER VIEW)
	TEST EQUIPMENT	Constant amplitude sine-wave generator INT (via A and B)
	INPUT VOLTAGE	Constant amplitude sine-wave signal, 120 mV, freq. 50 kHz...50 MHz to input A(B)
	SETTINGS	- Set A(B) to 20 mV/div. - Adjust the trace height to exactly 6 div. - Press TRIG VIEW (TRIG VIEW and A on) - Select A(B) as MTB trigger source and p-p as MTB trigger coupling - Increase the frequency up to 50 MHz
	REQUIREMENTS	- Check if the vertical deflection via TRIG VIEW is > 4,2 div.
	MEASURING RESULTS	

EXT

INPUT VOLTAGE	Constant amplitude sine-wave signal, 600 mV, freq. 50 kHz...50 MHz to input EXT
SETTINGS	- Select EXT DC as MTB trigger source - Adjust the trace height to exactly 6 div. - Increase the frequency up to 50 MHz.
REQUIREMENT	- Check if the vertical deflection via TRIG VIEW is > 4,2 div.
MEASURING RESULTS	

---

*	SUBJECT	Lower -3dB point of trigger view
	TEST EQUIPMENT	LF sine-wave generator
	INPUT VOLTAGE	Sine-wave signal of 10 Hz, 600 mV to input EXT
	SETTINGS	- Select EXT DC as MTB trigger source - Select TRIG VIEW as vertical display mode (TRIG VIEW and A) - Apply a 10 Hz, 600 mV sine-wave signal to input EXT - Decrease the frequency of the input signal, till the displayed amplitude is 4,2 div.
	REQUIREMENTS	- Check if the frequency of the input signal is much lower than 10 Hz (≈5Hz)
	MEASURING RESULTS	

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*	SUBJECT	Line jump trigger source
	TEST EQUIPMENT	-
	INPUT VOLTAGE	-
	SETTINGS	- Press TRIG VIEW (TRIG VIEW and A on) - Press TRIG or X SOURCE four times
	REQUIREMENTS	- Check if A, A and B, B, EXT DC and LINE are displayed via trigger view and if the jump between base line and the start of the LINE signal is < 2 subdiv.

---

*	SUBJECT	OFFSET of trigger point
	TEST EQUIPMENT	-
	INPUT VOLTAGE	-
	SETTINGS AND REQUIREMENT	- This check must be done in the SERVICE MENU "1°"To enter this menu proceed as follows: - Press MENU and keep it pressed and then press AUTO SET - Press V of channel A UP-DOWN control - Press MENU three times; "1.3" in LCD flashing - Turn Y POS of channel B and set the point in vertical centre of the screen. - Check if the displayed point does not jump more than 1,5 subdiv horizontally - Press MENU; "1.4" in LCD flashing - Turn Y POS of A and set point in the vertical centre - Check if the displayed point does not jump more than 1,5 subdiv. horizontally - Press MENU; "1.5" in LCD flashing - Turn Y POS of B and set point in vertical centre - Check if the displayed point does not jump more than 1,5 subdiv. - Press AUTO SET two times to leave the SERVICE MENU
	MEASURING RESULTS	

---

*	SUBJECT	Delay Difference between input A (B) and ext.TRIG VIEW
	TEST EQUIPMENT	Square wave calibration generator. (PG506)- 50 ohm T piece PM9584 and 50 ohm terminator (for EXT)
	INPUT VOLTAGE	Fast-rise input signal 1MHz, 0,5V, $\leq$1ns via 50 ohm T piece to input A/B and EXT input via 50 ohm terminator
	SETTINGS	- Apply fast-rise input signal to input A and EXT - Press AUTO SET and TRIG VIEW - Press TRIG or X SOURCE for EXT DC (AC) triggering - Set of A to 100mV - Press TB MAGN - Set INTENSITY fully clock-wise - Set MAIN TB to 5ns

	REQUIREMENTS	- Check if delay difference between the two displayed signal slopes is <10 ns (<2 div.)
	MEASURING RESULTS	

---

*	SUBJECT	Dynamic Range (EXT input via trigger view)
	TEST EQUIPMENT	Constant amplitude sine-wave generator
	INPUT VOLTAGE	Sine-wave signal of 1 MHz, 2,4 Vpp to input EXT
	SETTINGS	- Press TRIG VIEW (TRIG VIEW and A on) - Select EXT as MTB trigger source - Apply sine-wave signal 1 MHz, 2,4 V to input EXT - Shift with the MTB LEVEL control the sine-wave signal displayed via TRIG VIEW vertically over the screen.
	REQUIREMENT	- Check if the top and bottom of the sine-wave signal can be displayed distortion free (24 div. trace height)
	MEASURING RESULTS	
	INPUT VOLTAGE	Sine-wave signal of 50 MHz, 600 mVpp to input EXT
	SETTINGS	- Press TRIG VIEW on - Select EXT as MTB trigger source - Apply a sine-wave signal of 50 MHz, 600 mV to input EXT.
	REQUIREMENT	- Check if a sine-wave signal of 6 div. is displayed distortion-free
	MEASURING RESULTS	

2.4.5 HORIZONTAL DEFLECTION OR X-AXIS (characteristics section 2.3)

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*	SUBJECT	Horizontal Display modes and trace separation
	TEST EQUIPMENT	LF sine-wave generator

INPUT VOLTAGE	Sine wave signal 2 kHz, 3 div. trace height to input A
SETTINGS AND REQUIREMENTS	- Press AUTO SET - Set the trace height to 3 div. (MTB trace) - Set the MAIN TB to 0,5 ms/div. - Press TB SELECT - Set the DEL TB to 50 us/div. - Check if intensified part (DTB) is visible and if it can be shifted horizontally by the DTM control - Press TB SELECT - Check if DTB and MTB INTENS are on - Set the MTBI trace on the upper 3 div. - Turn TRACE SEP fully counter clockwise - Check if the bottom/half of the DTB signal can be > 4 div. shifted from the 100% graticule line - Set the MTBI trace on the lower 3 div. - Turn TRACE SEP fully clockwise - Check if the top half of the DTB signal can be > 4 div shifted from the 0% graticule line - Press TB SELECT - Check if only the DTB trace is displayed - Press TB SELECT - Check if only the MTB trace is displayed - Press X DEFL - Check if only X DEFL is on - Select A of MTB trigger source - Check if a line under an angle of 45^{o} is displayed.
MEASURING RESULTS	

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*	SUBJECT	Deflection coefficient (MTB)
	TEST EQUIPMENT	Time marker generator (TG501)
	INPUT VOLTAGE	Time marker signal 50 ns...0,5 s
	SETTINGS	- Apply a time marker signal of 50 ns to input A - Press AUTO SET

REQUIREMENT - Check the deflection coefficients in TB X1 and TB X10 according the table below:

Time marker pulse	MAIN TB setting ../div	Max. coeff. error MTB X1	Max. coeff. error MTB X10 TB MAGN on	Measuring results
50 ns	50 ns	3%	4%	(excl. first and last 50 ns)
0,1 us	0,1 us	3%	4%	
0,2 us	0,2 us	3%	4%	
0,5 us	0,5 us	3%	4%	
1 us	1 us	3%	4%	
2 us	2 us	3%	4%	
5 us	5 us	3%	4%	
10 us	10 us	3%	4%	
20 us	20 us	3%	4%	
50 us	50 us	3%	4%	
0,1 ms	0,1 ms	3%	4%	
0,2 ms	0,2 ms	3%	4%	
0,5 ms	0,5 ms	3%	4%	
1 ms	1 ms	3%	4%	
2 ms	2 ms	3%	4%	
5 ms	5 ms	3%	4%	
10 ms	10 ms	3%	4%	
20 ms	20 ms	3%	4%	
50 ms	50 ms	3%	4%	
0,1 s	0,1 s	3%	4%	
0,2 s	0,2 s	3%	4%	
0,5 s	0,5 s	3%	4%	

* SUBJECT Horizontal position range

TEST EQUIPMENT Time marker generator (TG501)

INPUT VOLTAGE Time marker signal of 1 ms to input A

SETTINGS AND REQUIREMENTS
- Set MAIN TB to 0,1 ms/div.
- Set a marker pulse on the first and last vertical graticule line
- Set X POS fully clockwise.
- Check if the first marker pulse is at the right side of the horizontal centre line
- Set X POS fully anti-clockwise
- Check if the last marker pulse is at the left side of the horizontal centre line.

MEASURING RESULTS

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*	SUBJECT	Variable control ratio (VAR MTB) and TB Magnifier balance
	TEST EQUIPMENT	Time marker generator (TG501)
	INPUT VOLTAGE	Time marker signal 1 us to input A
	SETTINGS	- Set MAIN TB to 0,2 us/div; marker on first and sixth graticule line - Set the MTB VAR fully anti-clockwise
	REQUIREMENT	- Check if the VAR control range overlaps the time base steps 0,2 us to 0,5 us; first marker on first graticule line and second marker on the third graticule line or closer to the first marker (2,5:1)
	SETTINGS	- Set the MTB VAR control fully clockwise - Set the top of the second marker pulse exactly in the horizontal centre of the graticule - Press TB MAGN (on)
	REQUIREMENT	- Check if the top of the second marker pulse is not shifted more than 2,5 subdiv.
	MEASURING RESULTS	

---

*	SUBJECT	Variable Hold Off
	TEST EQUIPMENT	Time marker generator (TG501)
	INPUT VOLTAGE	Time marker signal 10 ns to input A
	SETTINGS	- Set Hold-off control fully clockwise - Turn Hold-off anti-clockwise
	REQUIREMENT	- Check if the trace intensity decreases with a factor of 10 times the minimum Hold Off
	MEASURING RESULTS	

---

*	SUBJECT	Deflection Coefficients (DTB)
	TEST EQUIPMENT	Time marker generator (TG501)
	INPUT VOLTAGE	Time marker signal 1 ms...50 ns to input A

SETTINGS
- Press AUTO SET
- Press TB SELECT; MTBI and DTB on
- Set MAIN TB to 2 ms/div.
- Set DEL´D TB to 1 ms/div.
- Press DTB TRIG for STARTS mode
- Set the delay time to 5.000 ms by means of the DTM control.

REQUIREMENTS
- Check the deflection coefficients in TB x 1 and TB x 10 according the table below:

Attention: To check the DTB time coefficients according the table below the uS ofUP-DOWN MTB control must be operated (DTB setting is electrically coupled with MTB setting)

MAIN TB setting	Time marker pulse	DEL´D TB setting ../div	Max.coeff.error MTB X1	MTB X10	Measuring results
2 ms	1 ms	1 ms	3%	4%	
1 ms	0,5 ms	0,5 ms	3%	4%	
0,5 ms	0,2 ms	0,2 ms	3%	4%	
0,2 ms	0,1 ms	0,1 ms	3%	4%	
0,1 ms	50 us	50 us	3%	4%	
50 us	20 us	20 us	3%	4%	
20 us	10 us	10 us	3%	4%	
10 us	5 us	5 us	3%	4%	
5 us	2 us	2 us	3%	4%	
2 us	1 us	1 us	3%	4%	
1 us	0,5 us	0,5 us	3%	4%	
0,5 us	0,2 us	0,2 us	3%	4%	
0,2 us	0,1 us	0,1 us	3%	4%	
0,1 us	50 ns	50 ns	3%	4%	

* SUBJECT — Delay Time Multiplier

TEST EQUIPMENT — Time marker generator (TG501)

INPUT VOLTAGE — Time marker signal 10 us to input A

SETTINGS AND REQUIREMENTS	- Press TB SELECT; MTB INTENS and DTB on - Set MAIN TB to 5 us/div - Set DEL´D TB to 0,5 us/div. - Press DTM <-- (delay time: 0) - Check if the first marker pulse displayed via the DTB is partly visible; - Set the first marker displayed via the MTB exactly on the first graticule line - Press DTM --> (delay time 50 us) - Check if the last marker pulse displayed via the DTB is completely visible and if the Delay Time displayed in the LCD is >48 us. (3% + 1% incremental delay time error + [25 ns +/- 5 ns])
MEASURING RESULTS	

---

*	SUBJECT	Maximum Jitter (DTB)
	TEST EQUIPMENT	Sine-wave generator
	INPUT SIGNAL	Sine-wave signal (1 MHz), 6 div. trace height to input A.
	SETTINGS	- Set the trace height to 6 div. - Set MAIN TB to 1 ms - Press TB SELECT; MTBI and DTB on - Set DEL´D TB to 0,5 us - Set the DELAY time to 5 ms - Press TB SELECT; only DTB on
	REQUIREMENT	- Check if the jitter of the DTB trace is $\leq$ 1 div. (1 part per 20.000)
	MEASURING RESULTS	

---

*	SUBJECT	Horizontal Deflection coefficients
	TEST EQUIPMENT	Sine wave generator
	INPUT VOLTAGE	Sine wave signal 2 kHz, 4 div. trace height to input A
	SETTINGS	- Press EXT X DEFL - Press A/B twice for only ch. B display - Select A as X DEFL source with TRIG or X SOURCE
	REQUIREMENT	- Check if a horizontal line of 4 div. is displayed (+or- 5%).

INPUT VOLTAGE	- Sine wave signal 2 kHz, 1 V to input EXT
SETTINGS AND REQIREMENTS	- Select EXT with TRIG or X SOURCE - Press X DEFL - Check if a horizontal line of 10 div. (+or- 5%) is displayed. - Select LINE with TRIG or X SOURCE - Check if a horizontal line is displayed of approx 6 div. (at 220 V mains voltage)
MEASURING RESULTS	

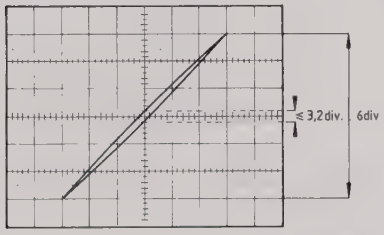
---

*	SUBJECT	Frequency response (horizontal)
	TEST EQUIPMENT	Constant amplitude sine-wave generator (PG506)
	INPUT VOLTAGE	Constant amplitude sine-wave signal, 30 mV, 50 kHz...2 MHz to input A
	SETTINGS	- Set A to 5 mV/div - Apply a 50 kHz sine-wave signal to input A - Adjust the trace height to exactly 6 div. - Press X DEFL - Select A as horizontal deflection source with TRIG or X SOURCE - Adjust the input voltage for exactly 6 div. horizontal deflection - Increase the frequency of the input signal up to 2 MHz
	REQUIREMENTS	- Check if the trace width is > 4,2 div. (-3 dB) over the complete bandwidth range.
	MEASURING RESULTS	
	TEST EQUIPMENT	LF Sine-wave generator
	INPUT VOLTAGE	Sine-wave signal, 10 Hz, 6 div. trace height to input A
	SETTINGS	- Set the vertical deflection of A to exactly 6 div. - Select X DEFL and A as X DEFL source - Decrease the frequency of the input signal.

	REQUIREMENT	- Check if the frequency of the input signal is much lower than 10 Hz at a trace width of 4,2 div.
	MEASURING RESULTS	

---

*	SUBJECT	Maximum phase shift between horizontal and vertical deflection.
	TEST EQUIPMENT	LF sine-wave generator
	INPUT VOLTAGE	Sine wave signal, 2 kHz...100 kHz, trace height 6 div.
	SETTINGS	- Press X DEFL - Select A for horizontal deflection with TRIG or X SOURCE - Set the trace height to exactly 6 div. - Increase the input frequency up to 100 kHz.
	REQUIREMENT	- Check if the phase shift < 3^{o} (see Fig. below)



MEASURING RESULTS	

2.4.6 MTB TRIGGERING (characteristics, section 2.4.1)

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*	SUBJECT	MTB Trigger Sources and trigger coupling
	TEST EQUIPMENT	Square-wave generator
	INPUT VOLTAGE	Square-wave signal 2 kHz, 4 div. trace height to input A (EXT)

SETTINGS AND REQUIREMENTS	- Set the trace height to 4 div. - Press TRIG VIEW (A and TRIG VIEW on) - Press TRIG COUPL and select DC - Adjust LEVEL MTB for a triggered signal - Check if two square wave signals are displayed of 4 div. (Trigger view and A) - Press TRIG COUPL and select p-p - Turn LEVEL MTB and check if the signal is triggered over the complete level range. - Connect CAL signal to input B - Set B to 200 mV. - Select B as MTB trigger source with TRIG or X SOURCE (A is not triggered) - Check if a square wave of 6 div. is displayed - Increase the freq. of the square-wave signal to input A up to 20 kHz (CAL signal to B) - Press TRIG or X SOURCE four times (A and B selected.) - Check if three well triggered traces are displayed; TRIG VIEW signal derived from A. - Remove input signals - Apply a square wave signal of 500 mV to input EXT - Select EXT as MTB trigger source with TRIG or X SOURCE - Check if a square wave signal is displayed via TRIG VIEW of 5 div. - Select LINE as MTB trigger source with TRIG or X SOURCE - Set MAIN TB to 5 ms/div - Check if a sine-wave signal (mains frequency) is displayed.
MEASURING RESULTS	

---

*	SUBJECT	MTB Slope selection and Level control range.
	TEST EQUIPMENT	LF Sine-wave generator
	INPUT VOLTAGE	Sine-wave signal 2 kHz - 800 mV to input A(B) (EXT)

SETTINGS AND REQUIREMENTS	- Set A(B) to 0,1 mV/div (DC input coupling) - Press TRIG COUPL for p-p triggering - Turn LEVEL MTB fully clockwise and fully anti-clockwise - Check if the signal is well triggered over the complete LEVEL range - Set the LEVEL MTB control in its mid-position - Start of signal display must be in the vertical centre - Press TB TRIG (TRIG mode) - Press SLOPE MTB - Check if the sine-wave signal is inverted and is triggered on the negative slope. - Press SLOPE MTB once again - Set A(B) to 50 mV/div (16 div. trace height) - Turn the LEVEL MTB - Check if the LEVEL range is > +or- 8 div. and if the signal is triggered on the positive slope. - Set A(B) to 0,1 V/div - Check if NOT TRIG´D is on, if the LEVEL control is set in its extreme positions - Remove input signal - Apply the sine-wave signal of 2 kHz, 1,6 Vpp to EXT - Select EXT (MTB trigger source) - Press TRIG VIEW. (TRIG VIEW and A(B) on) - Turn the LEVEL MTB - Check if the LEVEL range is > +or- 0,8 V (+or- 8 div.)
MEASURING RESULTS	

---

*	SUBJECT	Trigger Sensitivity (MTB)
	TEST EQUIPMENT	Sine-wave generator (SG503)
	INPUT VOLTAGE	Sine-wave signal 10 MHz-(50 MHz)-(100 MHz) to input A (B) (EXT)

SETTINGS AND REQUIREMENTS

- Press AC/DC (input coupling of A(B) to DC)
- Press TB TRIG MODE for TRIG mode
- Press TRIG COUPL for DC trigger coupling
- Apply a sine-wave signal of 10 MHz approx. 250 mVpp to input A(B)
- Set A(B) to 0,2 V/div.
- Decrease amplitude of input signal
- Turn LEVEL MTB
- Check if the signal is well-triggered at amplitudes $\geq$ 0,5 div.
- Decrease the frequency of the input signal to 50 kHz
- Check if the signal stays well triggered at amplitudes $\geq$0,5 div.
- Increase the frequency of the input signal up to 50 MHz.
- Decrease amplitude of input signal to approx 1 div.
- Turn LEVEL MTB
- Check if the signal is well-triggered at amplitudes $\geq$ 1 div.
- Increase the frequency of the input signal up to 100 MHz
- Decrease amplitude to approx 2 div.
- Check if the signal is well-triggered at amplitudes $\geq$ 2 div.
- Remove input signal
- Apply a sine wave signal of 100 MHz, 500 mVpp to input EXT (via external 50 Ohm terminator)
- Select EXT (MTB trigger source) with TRIG or X SOURCE
- Press TRIG VIEW, (TRIG VIEW and A(B) on).
- Turn LEVEL MTB
- Check if a well triggered sine-wave of 5 div. (500 mV) is displayed.
- Decrease amplitude of input signal
- Check if the signal is well triggered at amplitudes $\geq$ 500 mV (adjust LEVEL MTB)
- Decrease the frequency of the input signal to 50 MHz and the amplitude to 150 mV
- Check if the signal is well triggered (adjust LEVEL MTB)
- Decrease the frequency of the input signal to 10 MHz or lower
- Decrease the amplitude to 50 mV
- Check if the signal is well-triggered

MEASURING RESULTS

*	SUBJECT	Trigger sensitivity TVL-TVF
	TEST EQUIPMENT	TV pattern generator with video output (PM5518)
	INPUT VOLTAGE	Video signal to input A (B)
	SETTINGS	- Press TB TRIG mode for TRIG mode - Press AC/DC for DC input coupling - Apply a video signal to input A(B) with an amplitude of 0,7 div. sync. pulse amplitude - Press TRIG COUPL for TVL and TVF
	REQUIREMENTS	- Check for a stable triggering on TVL and TVF at sync. amplitudes of >0,7 div.
	MEASURING RESULTS	

2.4.7 DTB TRIGGERING (characteristics, section 2.4.2)

*	SUBJECT	DTB Trigger sources and trigger coupling
	TEST EQUIPMENT	Square-wave generator
	INPUT VOLTAGE	Square-wave signal 1 kHz, 4 div. trace height to input A(B) (EXT)
	SETTINGS AND REQUIREMENTS	- Set A(B) to 0,2V/div. - Press TB SELECT to select MTBI - Press DTB TRIG to select STARTS mode - Set MTB to 0,5 ms/div - Set DTB to 50 us/div - Set the delay to 2 ms with the DTM control - Turn LEVEL DTB - Check if the intensified part stays triggered and starts on the fifth vertical line - Press DTB to select A(B) - Check if the delay time is given in div. (4 div) - Turn LEVEL DTB - Check that in the extreme positions of the LEVEL control the DTB is not triggered. - Press TRIG DTB; check if A and B in composite are selected (DTB stays triggered) - Press TRIG DTB; check if B is selected as trigger source (DTB not triggered) - Press TRIG DTB; check if DTB is triggered via EXT (input signal also to input EXT) - Press TRIG DTB 3 times; check if A is selected
	MEASURING RESULTS	

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*	SUBJECT	DTB Trigger Sensitivity
	TEST EQUIPMENT	Sine-wave generator (SG503)
	INPUT VOLTAGE	Sine-wave signal 10 MHz (50 MHz) (100 MHz) to input A(B) (EXT)
	SETTINGS AND REQUIREMENTS	- Press TB SELECT; select MTBI - Press DTB TRIG; select A(B) as trigger source - Set MAIN B to 0,5 us/div - Set DEL´D TB to 50 ns/div - Turn LEVEL DTB to get a well triggered intensified part - Check the DTB trigger sensitivity according the procedure given in section 6.3 * The EXT trigger sensitivity must be checked via channel A (input signal to EXT and A) * Read DTB instead of MTB
	MEASURING RESULTS	

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*	SUBJECT	DTB Slope selection and Level control range
	TEST EQUIPMENT	LF Sine-wave generator
	INPUT VOLTAGE	Sine-wave signal 2 kHz - 800 mVpp to input A(B) (EXT)
	SETTINGS AND REQUIREMENTS	- Set A(B) to 0,1 mV/div (8 div) - Select MTBI with TB SELECT - Set MAIN TB to 0,2 ms /div and DEL´D TB to 5 us/div. - Press DTB TRIG: source A(B) - Turn LEVEL DTB for a well triggered intensified part. - Press SLOPE DTB - Check if the intensified part is on the negative slope. - Press SLOPE DTB (positive triggering) - Set DEL´D TB to 0,1 ms/div. - Set A(B) to 50 mV/div. - Turn LEVEL DTB - Check if the LEVEL DTB range is > +or- 8 div.

2.4.8		AUXILIARY INPUTS AND OUTPUTS
*	SUBJECT	Z-MOD Sensitivity
	TEST EQUIPMENT	Square-wave generator
	INPUT VOLTAGE	Square-wave signal, 1 kHz, duty cycle 50%, amplitude 0...5 Vpp to input A and Z-in (rear side)
	SETTINGS AND REQUIREMENTS	- Set MAIN TB to 0,5 ms/div. - Set the trace of A in mid-position - Select DC for channel A Input coupling - Apply square-wave signal of 2,5 Vpp, 1 kHz to input A and Z-in. (base line 0 V) - Check if only the bottom half of the square wave signal is displayed (500 us blanking and 500 us unblanking) - Decrease the amplitude of the input signal to 1 Vpp. - Set A to 0,5 V/div. - Check if the top half of the square-wave signal is visible with a lower intensity and will be completely unblanked at an input voltage of < 0,8 V
	MEASURING RESULTS	

*	SUBJECT	CAL Frequency and output voltage
	TEST EQUIPMENT	-
	INPUT VOLTAGE	CAL output signal to input A
	SETTINGS	- Press 0 of channel A - Set the trace in the centre of the screen - Press 0 of channel A - Select DC of A input coupling
	REQUIREMENTS	- Check if a positive going square wave signal is displayed of 1,2Vpp, frequency 2 kHz
	MEASURING RESULTS	

3. OPTIONS

The following chapter contains the complete description of the possible options for PM3055. It can be filed under chapter 17 of the Service manual.

Contents: 3.1. Y-OUT
3.2. MTB gate, DTB gate and MTB sweep

3.1 Y-OUT

3.1.1 Characteristics

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Y-out	via channel A	
Defl. coeff.	100 mV/div. +/- 10%	at R_{load} > 10 kOhm
	50 mV/div. +/- 10%	at R_{load} = 50 Ohm
* Bandwidth	> 50 MHz	- 3 dB, input 6 div. sinewave
* Pulse aberrations		
LF pulse drop or	< 2%	at R_{load}= 500 Ohm
tilt	< 3%	at R_{load}> 10 kOhm
		5 div. pulse; +or- 2,5 div. from screen centre.
* HF pulse aberrations	< 6%	5 div. pulse (ac coupled)
* Dyn. range	+or- 12 div.	at 10 MHz
	> 6%	at 50 MHz
* DC output level	0 V	
Output drift ($10^{o}C$-$40^{o}C$)	< 50 mV	

3.1.2 Circuit description

The Y-OUT circuit receives its input current from the signal splitter D2002, pin 6 and 11 on the pre-amplifier unit. The symmetrical input is buffered by two common-base amplifiers V203. These two transistors are matched for a common Vbc to compensate temperature drift.
The symmetrical current signals are then converted into the asymmetrical Y-OUT voltage via the short-feedback amplifier N201-6,7,8. The amplitude of this Y-OUT voltage is the summation of the voltage across resistor R219 and R226. The offset can be adjusted to 0 V by means of potentiometer R201. Transistor V206 serves as the current source of this final stage.

3.1.3 Adjusting and checking procedure

Refer to figure 5.1 for location of the adjusting points.

Note: Be sure that the oscilloscope is well adjusted before starting this adjusting procedure.

Gain adjustment:
- Apply a 100 mV/1 kHz calibrated square-wave signal to input A.
- Connect the Y OUT output to input B by means of a coax cable.
- Press AUTO SET key.
- Set UP-DOWN ch. A to 20 mV.
- Set UP-DOWN ch. B to 0,1 V.
- Press AC/DC key ch. A for DC input coupling.
- Press AC/DC key ch. B for DC input coupling.
- Press ALT/CHOP key for chopped display.
- Press ADD/INVERT key for a channel A minus channel B display
- Adjust R209 for a straight line display (tolerance: +or- 1,5 subdiv.)

Offset adjustment:
- Apply a 100 mV/1 kHz calibrated square-wave signal to input A.
- Connect the Y OUT output to input B by means of a coax cable.
- Press AUTO SET key.
- Press 0 key ch. A.
- Connect a digital multimeter to the Y-OUT connection of the BNC socket and the BNC-ground.
- Adjust R201 so that the output voltage is 0 V (tolerance: +or- 10 mV)

Checking the gain:
- Apply a 100 mV/1 kHz calibrated square-wave signal to input A.
- Connect the Y OUT output to input B by means of a coax cable.
- Press AUTO SET key.
- Set UP-DOWN ch. A to 20 mV.
- Set UP-DOWN ch. B to 0,1 V.
- Press AC/DC key ch. A for DC input coupling.
- Press AC/DC key ch. B for DC input coupling.
- Press A/B key for only ch. B display.
- Ensure that the amplitude of the displayed signal is 5 div. (tolerance: +or- 1,5 subdiv.)

- Terminate ch. B with 50 Ohm.
- Set UP-DOWN ch. B to 50 mV.
- Ensure that the amplitude of the displayed signal is 5 div. (tolerance: +or- 1,5 subdiv.

HF square-wave response adjustment:
- Apply a 120 mV/1 MHz calibrated square-wave signal with rise time faster than 1 nsec to input A.
- Connect the Y OUT output to a PM3295 oscilloscope means of a coax cable. (Input: 50 Ohm, sensitivity: 50 mV/div)
- Press AUTO SET key
- Set UP-DOWN ch. A to 20 mV.
- Press AC/DC key ch. A for DC input coupling.
- Ensure that the PM3295 displays a square wave signal of 6 div p-p approx.
- Adjust R223 and C203 for an optimal square-wave response.

Y-OUT bandwidth check:
- Apply a 120 mV/1 MHz sine-wave to input A.
- Connect the Y-OUT output to a PM3295 oscilloscope by means of a coax cable. (input: 50 Ohm, sensitivity: 50 mV/div).
- Press AUTO SET key.
- Set UP-DOWN ch. A to 20 mV.
- Press AC/DC key ch. A for DC input coupling.
- Ensure that the amplitude of the displayed signal of the PM3295 oscilloscope is 6,0 div.; if necessary, readjust the amplitude of the input signal.
- Now, increase the frequency of the input signal to 50 MHz.
- Ensure that the amplitude of the displayed signal on the PM3295 is at least 5,0 div. p-p.

Checking the dynamic range:
- Apply a 0,25 V/50 MHz sine-wave to input A.
- Connect the Y-OUT output to PM3295 oscilloscope by means of a coax cable. (input: 50 Ohm, sensitivity: 200 mV/div).
- Press AUTO SET key.
- Set UP-DOWN ch. A to 20 mV.
- Press AC/DC key ch. A for DC input coupling.
- Ensure that the displayed signal is shown without distortion or clipping.

- Change the input signal to 0,52 V/10 MHz sine wave.
- Change UP/DOWN ch. A to 20 mV.
- Ensure that the displayed signal is shown without distortion or clipping.

3.1.4 Parts list

POS.NR	DESCRIPTION	ORDERING CODE
C201	10nF -20+150% 100V	4822 122 31414
C202	100pF -2% 100V	4822 122 31316
C203	10pF TRIM CAP	5322 125 11013
C204	1nF -10% 100V	4822 122 30027
C251	68uF -10+50% 16V	4822 124 20689
C252	10nF -20+50% 100V	4822 122 31414
C253	10nF -20+50% 100V	4822 122 31414
C254	68uF -10+50% 16V	4822 124 20689
C256	10nF -20+50% 100V	4822 122 31414
C257	10nF -20+50% 100V	4822 122 31414
R201	2K2 25% 0,3W	5322 105 20033
R202	16K2 1% MR25	5322 116 53589
R203	1K33 1% MR25	5322 116 53512
R204	1K33 1% MR25	5322 116 53512
R206	100E 1% MR25	5322 116 53126
R207	100E 1% MR25	5322 116 53126
R208	7K5 1% MR25	5322 116 53028
R209	2K2 25% 0,3W	5322 105 20033
R211	348E 1% MR25	5322 116 53591
R212	51E1 1% MR25	5322 116 53213
R213	51E1 1% MR25	5322 116 53213
R214	23K7 1% MR25	5322 116 53537
R216	287E 1% MR25	5322 116 53221
R217	287E 1% MR25	5322 116 53221
R218	100E 1% MR25	5322 116 53126
R219	825E 1% MR25	5322 116 53541
R221	6K19 1% MR25	5322 116 53263
R222	1K78 1% MR25	5322 116 53208
R223	470E 25% 0,3W	5322 105 20028
R224	10E 1% MR25	5322 116 52891
R226	825E 1% MR25	5322 116 53541
R227	1K33 1% MR25	5322 116 53512
R228	287E 1% MR25	5322 116 53221
R229	51E1 1% MR25	5322 116 53213
R231	1K21 1% MR25	5322 116 52952
R232	1K 1% MR25	5322 116 53108
R233	348E 1% MR25	5322 116 53591
R251	5E11 1% MR25	4822 116 52999
R252	5E11 1% MR25	4822 116 52999
R253	5E11 1% MR25	4822 116 52999
V201	BAW62	4822 130 30613
V202	BAW62	4822 130 30613
V203	BF324 select	5322 693 90465
V204	BAW62	4822 130 30613
V206	BF370	4822 130 42589
N201	CA3127E	5322 130 42627
X204	3-P SNG-90°	5322 265 30433
3x	50 Ohm bus conn.	5322 268 24116
3x	50 Ohm pen conn.	5322 268 14141

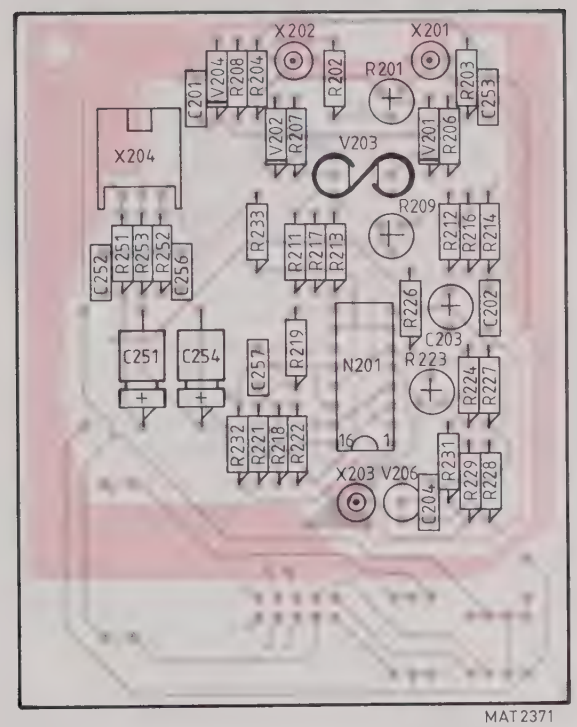


Figure 3.1 Y-OUT pcb

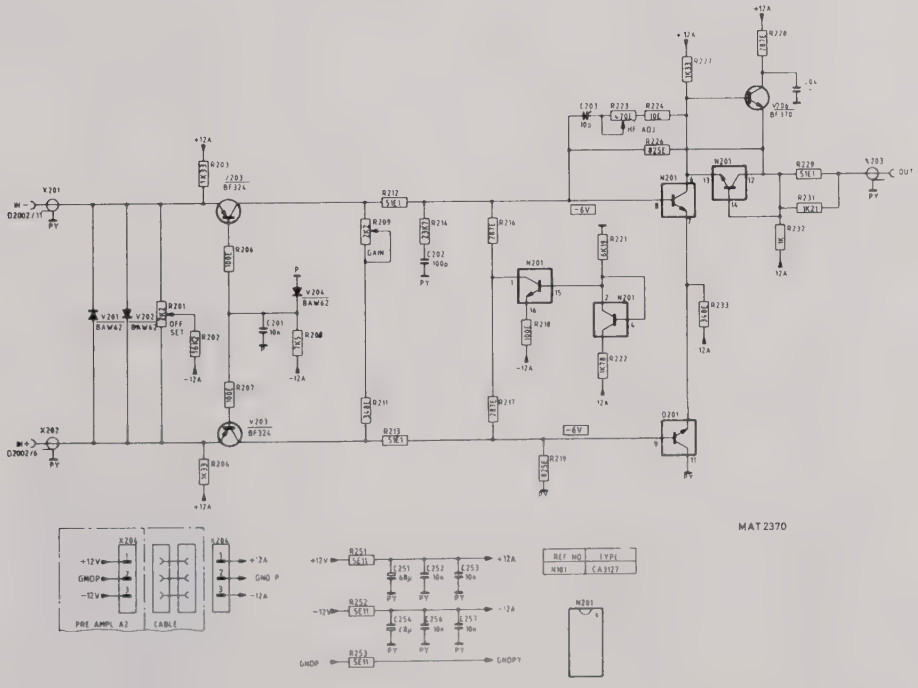


Figure 3.2 Circuit diagram of Y-OUT option

3.2 MTB GATE, DTB GATE AND MTB SWEEP

3.2.1. MTB gate

The BNC output socket gives a TTL-compatible signal, which is HIGH during the MTB sweep and LOW for other conditions.

Characteristics	Specification	Additional information
* Output voltage LOW	< 0,4 V	at +4 mA
* Output voltage HIGH	> 2,4 V	at -4 mA

3.2.2 DTB gate (PM3055, PM3056 only)

The BNC output socket gives a TTL-compatible signal, which is HIGH during the DTB sweep and LOW for other conditions.

Characteristics	Specification	Additional information
* Output voltage LOW	< 0,4 V	at +4 mA
* Output voltage HIGH	> 2,4 V	at -4 mA

3.2.3 MTB sweep

The BNC output socket gives the MTB sawtooth signal.

Characteristics	Specification	Additional information
* Output voltage	0,5 V/div. +or-2,5%	at $R_{load} \geq$ 1 Meg-Ohm
* Linearity	< 3%	for definition, see MTB spec. in your Service manual.
* Output impedance	1 kOhm +or-2%	
* Offset voltage	< 250 mV	

3.2.4 Parts list

POS.NR	DESCRIPTION	ORDERING CODE
C421	10 nF -20+50% 100 V	4822 122 31414
C422	10 nF -20+50% 100 V	4822 122 31414
C423	10 nF -20+50% 100 V	4822 122 31414
R401	10 E 1% MR25	5322 116 52891
R402	10 E 1% MR25	5322 116 52891
R403	100 E 1% MR25	5322 116 53126
R404	100 E 1% MR25	5322 116 53126
R406	1 E 1% MR25	4822 116 52167
R407	10 E 1% MR25	5322 116 52891
R408	5k11 1% MR25	5322 116 53494
R409	5k11 1% MR25	5322 116 53494
R411	1 K 1% MR25	5322 116 53108
R421	5E11 1% MR25	5322 116 52999
R422	5E11 1% MR25	4822 116 52999
R423	5E11 1% MR25	4822 116 52999

POS.NR	DESCRIPTION	ORDERING CODE
V401	BC558B	4822 130 44197
V402	BC548C	4822 130 44196
D401	PC74HCT132P	4822 209 83044
3x 50 Ohm bus		5322 268 24116
3x 50 Ohm pin		5322 268 14141

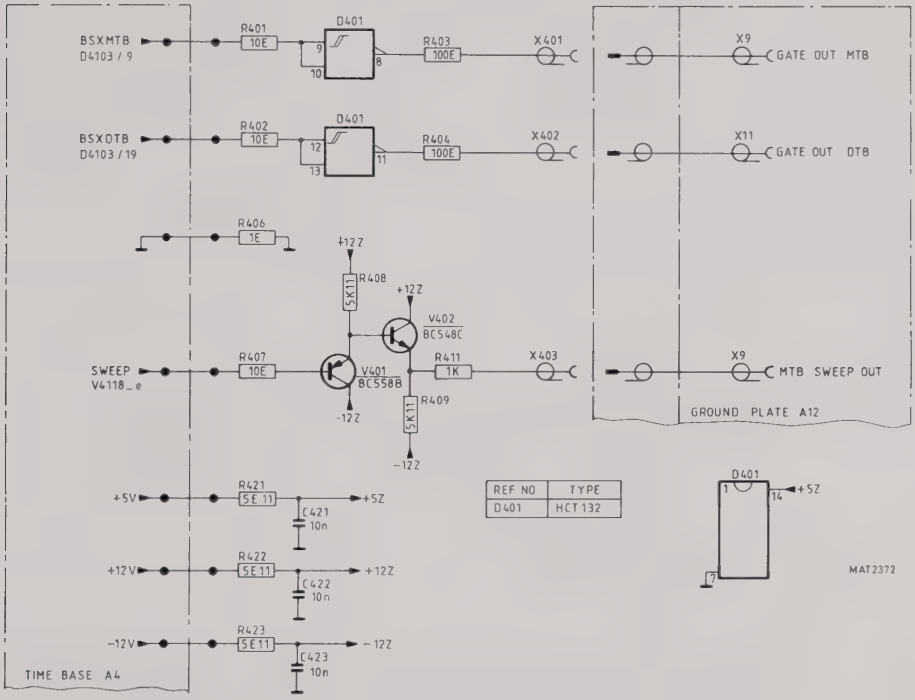


Figure 3.3 Circuit diagram of MTB gate, DTB gate and MTB sweep options

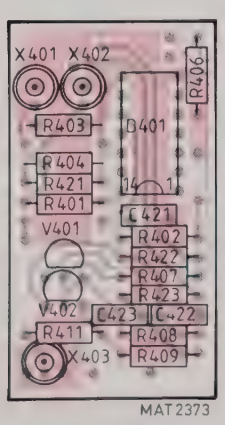


Figure 3.4 Pcb for MTB gate, DTB gate and MTB sweep

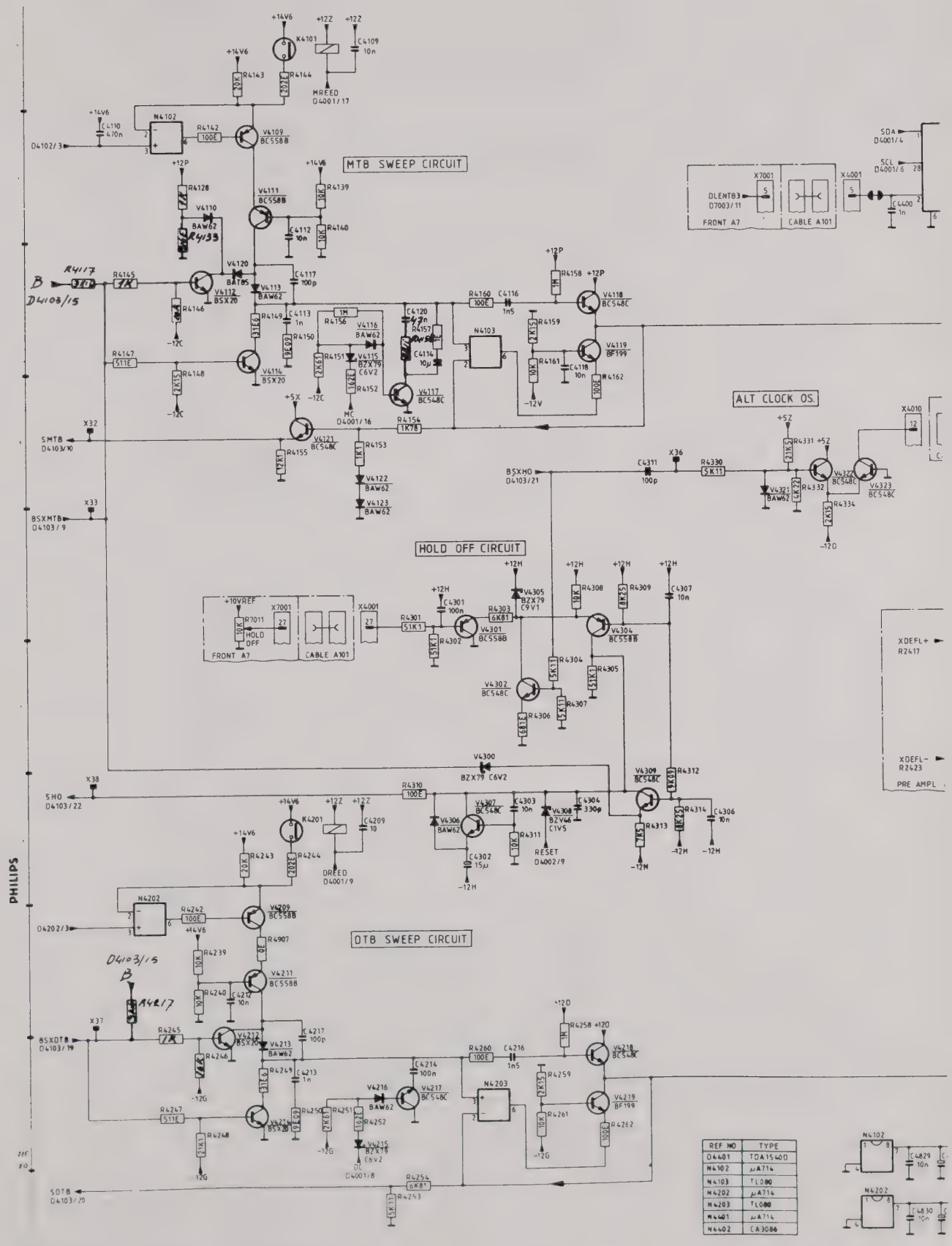
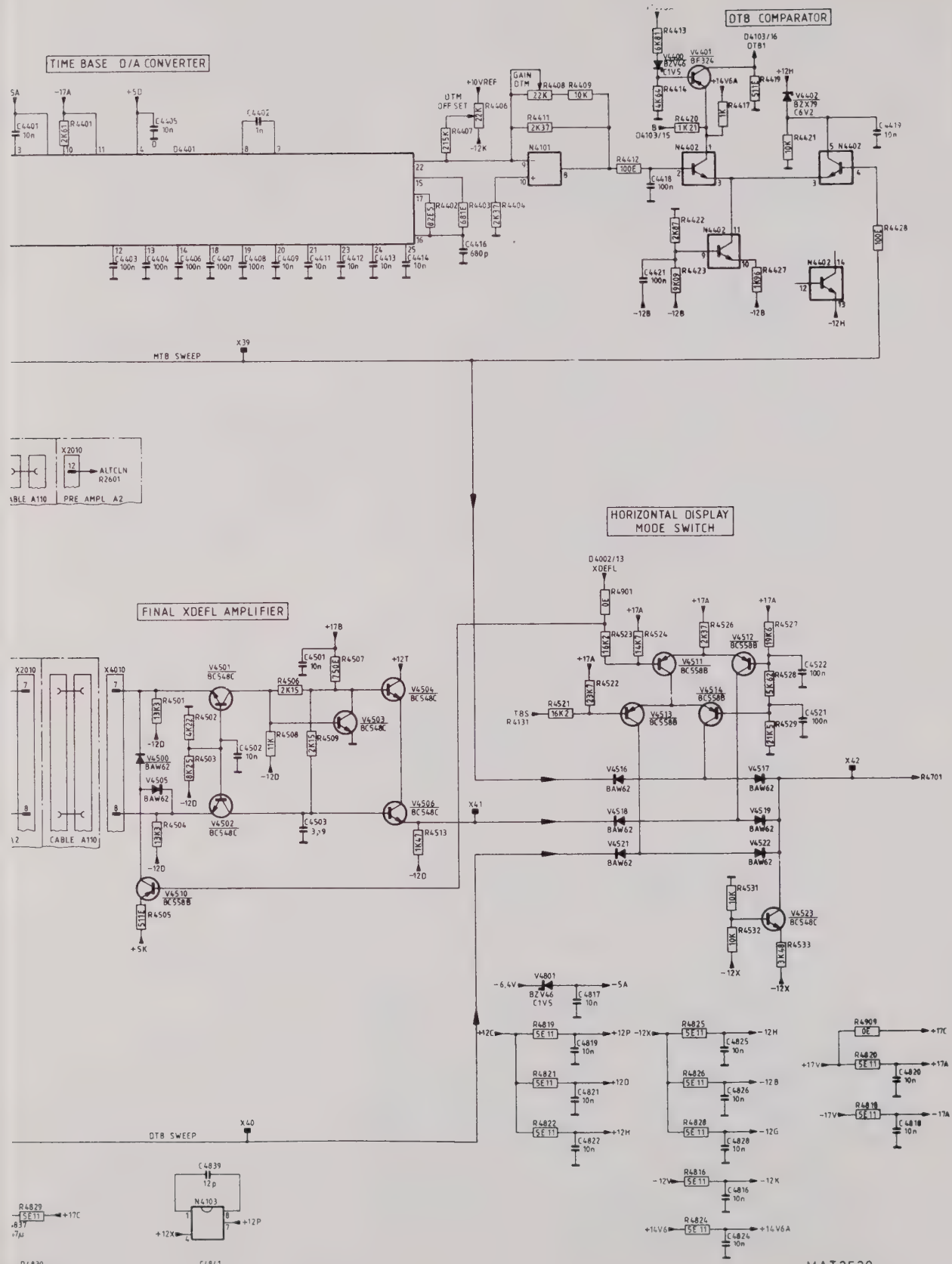


Figure 4.1 Part of Time-base unit, showing the modified hold-off circuit


TIME BASE D/A CONVERTER
DTB COMPARATOR
MTB SWEEP
X39
HORIZONTAL DISPLAY MODE SWITCH
FINAL XDEFL AMPLIFIER
X2010
ALTCLN R2601
CABLE A110
PRE AMPL A2
X4010
CABLE A130
X42
X41
X40
DTB SWEEP
MAT2520

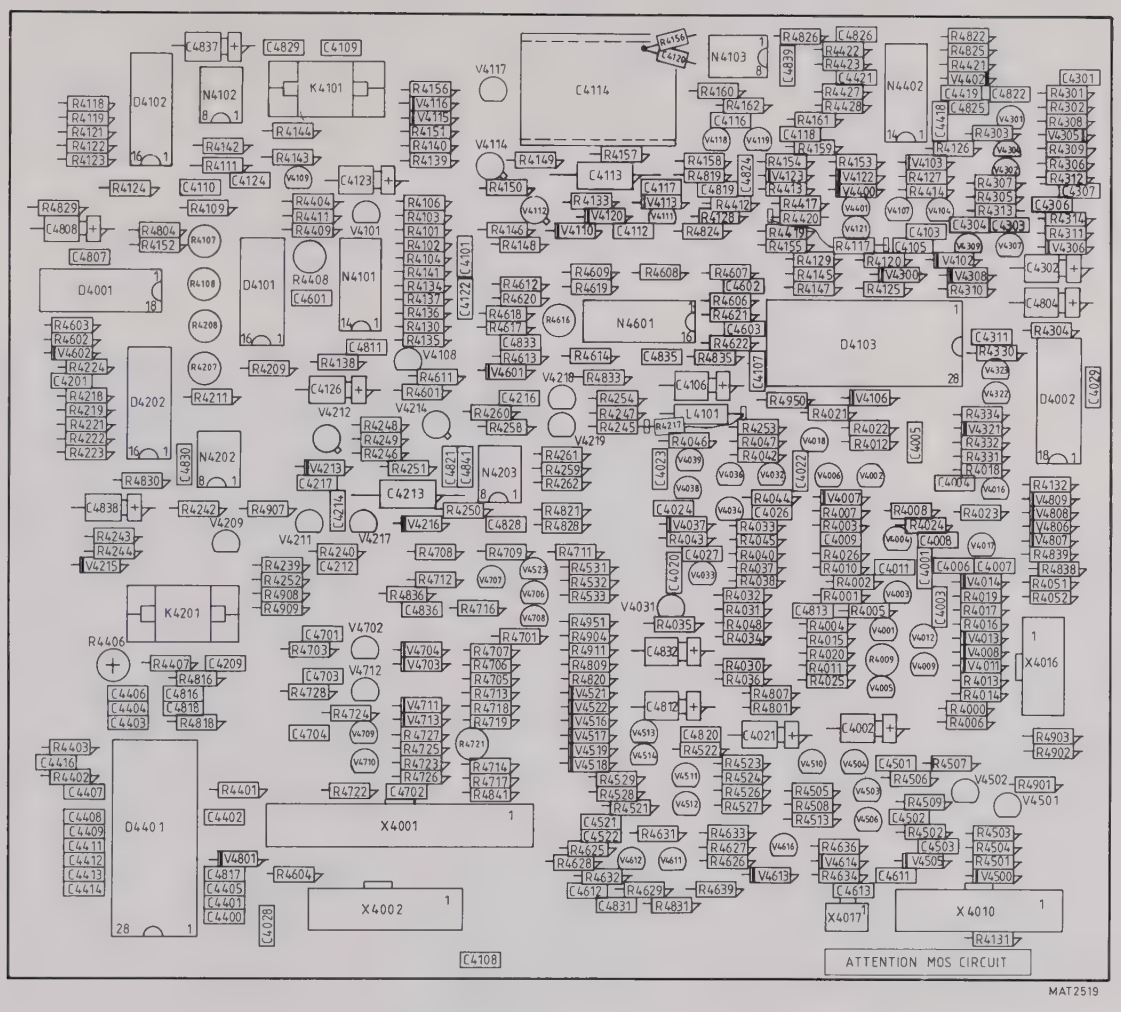


Figure 4.2 New time base unit p.c.b

The codenrs of the new components are:

C4116	1N5	(4822 122 31169)	
C4216	1N5	(4822 122 31169)	
C4304	330 pF	(.... ... .)	
C4311	100 pF	(4822 122 31316)	
R4117	3K16- MRS25	(5322 116 50579)	
R4128	5K11- MRS25	(4822 116 54595)	new component
R4133	1K - MRS25	(4822 116 51235)	new component
R4145	1K - MRS25	(4822 116 53108)	
R4146	10K - MRS25	(4822 116 53022)	
R4148	21K5- MRS25	(5322 116 53241)	
R4217	3K16- MRS25	(5322 116 50579)	
R4245	1K - MRS25	(4822 116 53108)	
R4246	10K - MRS25	(4822 116 53022)	
R4303	6K81- MRS25	(4822 116 51252)	
R4304	5K11- MRS25	(5322 116 54595)	
R4305	51K1- MRS25	(5322 116 50672)	new component
R4306	681E- MRS25	(4822 116 51233)	
R4307	5K11- MRS25	(5322 116 54595)	
R4308	10K - MRS25	(4822 116 51252)	
V4110	BAW62	(4822 130 30613)	new component
V4120	BAT85	(4822 130 31983)	new component
V4300	BZX79-C6V2	(4822 130 34167)	new component
V4305	BZX79-C9V1	(4822 130 30862)	new component
V4303	cancelled		

Also the following components have been changed:

C4127 into 10 pF	(4822 122 32185)	
C4839 into 12 pF	(4822 122 31056)	
C4841 into 12 pF	(4822 122 31056)	
R4102 into 4K64-MRS25	(5322 116 50484)	
R4103 into 11K -MRS25	(5322 116 54623)	
R4104 into 100K-MRS25	(4822 116 51268)	

* V4166 has been cancelled.

4.5 UNIT 6 POWER SUPPLY UNIT

* C6214-470 pF (5322 122 50086) has been added between X6008-3 and ground

* - L6002 is cancelled
  - R6500 is cancelled
  - V6006 is replaced by a wire-bridge
  - Series connection of C6018-4N7 (4822 122 31125) and R6019-21E5, MRS25 (5322 116 50677) connected across T6001-1,2.
  - C6134, 1 NF (4822 122 30027), connected across V6131.

RI-SA3
458

50 MHz Dual Time Base Oscilloscope

PM3055

Service Manual

4822 872 05311
860321/1

I&E

Industrial & Electro-acoustic Systems Division

PHILIPS

Industrial &
Electro-acoustic Systems

PHILIPS

50 MHz Dual Time Base Oscilloscope

PM3055

Service Manual

4822 872 05311
860321/1

MAT2220

WARNING! These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock do not perform any servicing other then that specified in the Operating Instructions unless you are fully qualified to do so.

PHILIPS

IMPORTANT: In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

NOTE: The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.

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1. SAFETY INSTRUCTIONS

Read these pages carefully before installation and use of the instrument.

1.1 INTRODUCTION

The following clauses contain information, cautions and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition.
Adjustment, maintenance and repair of the instrument shall be carried out only by qualified personnel.

1.2 SAFETY PRECAUTIONS

For the correct and safe use of this instrument it is essential that both operating and servicing personnel follow generally-accepted safety procedures in addition to the safety precautions specified in this manual.
Specific warning and caution statements, where they apply, will be found throughout the manual.
Where necessary, the warning and caution statements and/or symbols are marked on the apparatus.

1.3 CAUTION AND WARNING STATEMENTS

CAUTION : is used to indicate correct operating or maintentance procedures in order to prevent damage to or destruction of the equipment or other property.

WARNING : calls attention to a potential danger that requires correct procedures or pracites in order to prevent personal injury.

1.4 SYMBOLS

High voltage $\geq$ 1000 V (red)

Live part (black/yellow)

Read the operating instructions

Protective earth (grounding) terminal (black)

1.5 IMPAIRED SAFETY-PROTECTION

Whenever it is likely that safety-protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation. The matter should then be referred to qualified technicians.
Safety protection is likely to be impaired if, for example, the instrument fails to perform the intended measurements or shows visible damage.

1.6 GENERAL CLAUSES

1.6.1 WARNING : The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals which can be dangerous to live.

1.6.2 The instrument shall be disconnected from all voltage sources before it is opened.

1.6.3 Bear in mind that capacitors inside the instrument can hold their charge even if the instrument has been separated from all voltage sources.

1.6.4 WARNING : Any interruption of the protective earth conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.

1.6.5 Components which are important for the safety of the instrument may only be renewed by components obtained through your local Philips organisation. (See also Section 15).

1.6.6 After repair and maintenance in the primary circuit, safety inspection and tests, as mentioned in Section 15 have to be performed.

2. CHARACTERISTICS

A. Performance Characteristics

- Properties expressed in numerical values with stated tolerance are guaranteed by PHILIPS Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical instruments.
- This specification is valid after the instrument has warmed up for 30 minutes (reference temperature 23°C).
- For definitions of terms, reference is made to IEC Publication 351-1.

B. Safety Characteristics

- This apparatus has been designed and tested in accordance with Safety Class I requirements of IEC Publication 348, Safety requirements for Electronic Measuring Apparatus, UL 1244 and CSA 556B and has been supplied in a safe condition.

C. Initial Characteristics

. Overall dimensions:

- Width

Including handle	: 387 mm
Excluding handle	: 350 mm

- Length

Including handle, excl. knobs	: 518,5 mm
Excluding handle, excl. knobs	: 443,5 mm
Including handle, incl. knobs	: 530,5 mm
Excluding handle, incl. knobs	: 455,5 mm

- Height

Including feet	: 146,5 mm
Excluding feet	: 134,5 mm
Excl. under cabinet	: 132,5 mm

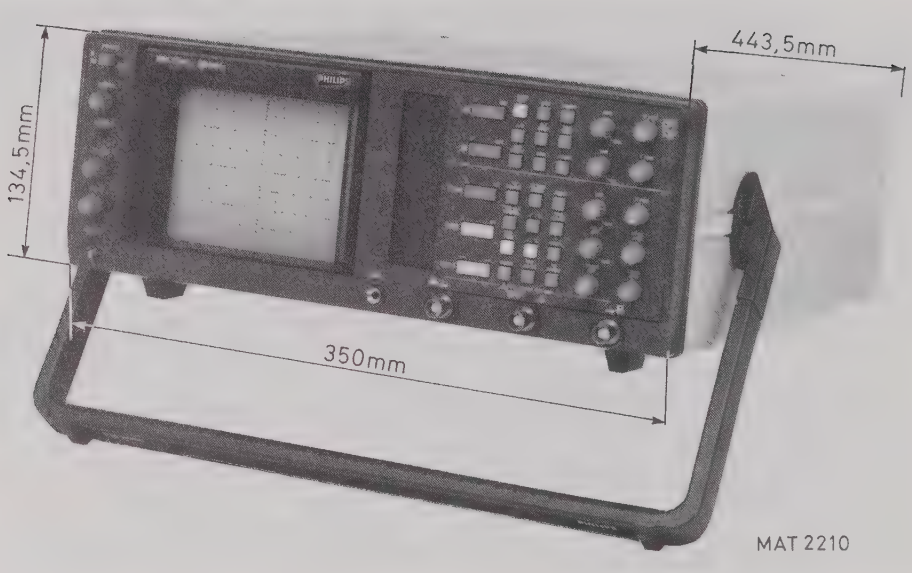

Figure 2.1 Dimensions

* Mass : 7,5 kg

* Operating positions:
  a. Horizontally on bottom feet
  b. Vertically on rear feet
  c. On the carrying handle in two sloping positions.

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2.2. Vertical deflection or Y axis
2.3. Horizontal deflection or X axis
2.4. Triggering
2.5. Power Supply
2.6. Auxiliary inputs or outputs
2.7. Environmental characteristics
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2.1 DISPLAY

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* CRT		
Type No	PHILIPS D 14-372	
Measuring area (h x w)	80 x 100 mm	8 x 10 div. 1 div. = 10 mm 1 subdiv. (sd) ≒ 2 mm
* Screen type		
Standard	GH (P 31)	
Option	GM (P 7)	Long persistence
* Total acceleration voltage	16 kV	
* Graticule		
Engravings	Internal fixed	
Division lines	1 cm	Horizontal as well as vertical
Subdivisions	2 cm	Idem.
Dotted lines	1,5 and 6,5 cm from top	Only horizontal.
Percentages	0%, 10%, 90%, 100%	Left and right side.
* Orthogonality	90% +/- 1^{o}	Measured in zero point.
* Illumination	Continuously variable	
* Display time per channel in chopped mode	< 2 us	
* LCD liquid crystal display		All relevant settings are visible in display.
Type No	LC 9438130	
Visible area	25,4 x 88,8 mm	
Back lighting	Permanently on	

2.2 VERTICAL DEFLECTION OR Y AXIS

2.2.1 Channels A and B

* Deflection coeff.	2 mV/div.:10 V/div.	In 1, 2, 5 sequence.
* Variable gain control range	1 : >2,5	If PM 8936/09 is used, deflection coeff. is automatically calculated in display.
* Error limit	< +/- 3%	Only in calibrated position.
* Input impedance	1 M ohm +/-2%	Measured at f_o < 1 MHz
Paralleled by	20 pF +/-2pF	Measured at f_o < 1 MHz
Max. input voltage	400 V (d.c + a.c. peak)	
Max. test voltages (rms)	500 V	Max. duration 60 sec.
* Bandwidth for 20 mV up to 10 V @ 25°C (50 MHz & 6 div.)	> 50 MHz	Input 6 div. sine-wave.
Bandwidth for 2 mV, 5mV and 10 mV @ 25°C (35 MHz & 6 div.)	> 35 MHz	Input 6 div. sine-wave.
* Rise-time	7 ns or less	Calculated from 350/f-3 dB
* Pulse aberration Overshoot, ringing and rounding	< 1,5 sd peak to peak	Input pulse 5 div., +/- 2,5 div. from screen centre, positive as well as negative pulse.
Duration of ringing	20 ns	Ringing has ended when amplitude is 1/3 of starting amplitude.
* Hole or bump	< 0,7 sd (peak)	
* Drop or tilt	< 0,7 sd (peak)	
* Noise 20 mV : 10 V	< 0,5 sd	Measured visually. Pick up on open BNC excluded.
* Lower - 3 dB point Amplitude 6 div. 10 Hz @ 25°C	< 10 Hz	In AC position, 6 div. sine-wave

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Dynamic range		
@ 10 MHz	> +/- 24 div.	Vernier in cal. position.
@ 50 MHz	> 8 div.	Vernier in cal. position.
* Position range	> +/- 8 div.	Vernier in cal. position.
* Decoupling factor between channels		Both channels same attenuator setting. Input max. 8 div. sine-wave.
@ 10 MHz	1 : > 100	2,5 and 10 mV are excluded.
@ 50 MHz	1 : > 50	2,5 and 10 mV are excluded.
* Common Mode Rejection Ratio @ 1 MHz	1 : > 100	Both channels same attenuator setting, vernier adjusted for best CMMR; measured with max. 8 div. (+/- 4 div.) each channel.
* L.F. Linearity Amplitude 2 div. input signal when shifted over screen (vertical)	< 3%	2 div. sine-wave 50 kHz adjusted in screen centre.
* Visible signal delay	> 15 ns	Max. intensity, measured from line start to trigger point (to be checked in trigger view).
* Base-line jump between attenuator steps 20 mV : 10 V	< 1 sd	
Additional jump between 10 mV <---> 20 mV	< 1,5 sd	
Normal Invert jump	< 1 sd	Only channel B.
ADD jump	< 0,6 div.	When A and B are positioned in screen centre (20 mV : 10 V).
Variable jump	< 1 sd	Max.jump in any position of the vernier.

2.2.2 Triggerview

* Bandwidth		
Via A or B channel 20 mV up to 10 V@ 25°C	> 50 MHz	6 div. sine-wave
Via EXT. input	> 50 MHz	6 div. sine-wave (+/- 3 div. from screen centre).
* Deflection coeff.		
Via channel A or B	2 mV : 10 V/div.	1, 2, 5 sequence (see Channel A, B).
Via EXT. input	100 mV/div.	
Error limit	< 5%	INTERNAL, EXTERNAL.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Lower - 3 dB point AC coupling EXT. input @ 25°C input sine-wave 6 div. 10 Hz	< 10 Hz	Only when trigger mode is DC.
* Line jump trigger source	< 2 sd	Jump between trigger source A, B composite and EXT.
* OFFSET trig.point from screen centre	< 1,5 sd	
* Delay EXT. trigger view and channel A or B	< 10 ns	
* Dynamic range EXT. input		
@ 1 MHz	> +/- 12 div.	
@ 50 MHz	> 6 div.	

2.3 HORIZONTAL DEFLECTION OR X AXIS

* Horizontal display modes	MTB, MTBI, ALT.TB, DTB	

2.3.1 Main Time Base (MTB)

* Time coeff.	0,5 sec. : 50 ns	1, 2, 5 sequence (magn.off)
* Error limit	< 3%	Measured at -4 : +4 div. from screen centre.
* Horizontal position range	Start of sweep and 10th div. must be shifted over screen centre	
* Variable control ratio	1 : > 2,5	
* Time Base magnifier	Expansion *10	Not valid in X-deflection.
* Error limit	< 4%	Measured at +4 : - 4 div. from screen centre. Excluding first 50 ns and last 50 ns.
* Horizontal magnifier balance * 10 ---> * 1	< 2,5 sd	Shift start of sweep in * 10 in mid-screen position, then switch to * 1.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Hold-Off Minimum to maximum hold-off time ratio	1 : > 10	Minimum hold off time is related to time base setting.

2.3.2 Delay Time Base (DTB)

* Time coeff.	1 ms : 50 ns	Sequence 1, 2, 5.
* Error limit		See MTB
* Linearity		See MTB
* Horizontal temp. coeff.		See MTB
* Horizontal position range		See MTB
* Variable control ratio		See MTB
* Time Base Magnifier		See MTB
* Delay time Multiplier Error limit	3% + 1% incremental delay error + 25 ns +/- 5 ns	* 1 only
Incremental delay time error	< 1%	* 1 only
* Resolution	1 : 10 000	
* Delay Time Jitter MTB 1 us; DTBO 0,1 ms; *10	1 : > 20 000	
* Trace separation		Only valid in alternate time base.
* Shift range	> +/- 4 div.	DTB shifts only.

CHARACTERISTICS	SPECIFIC@TION	ADDITIONAL INFORMATION
2.3.3 X-deflection		
* Deflection coeff.		
Via channel A or B	2 mV : 10 V/div.	1, 2, 5 sequence.
Via EXT. input	100 mV/div.	
* Error limit		
Via channel A or B	< +/- 5%	
Via EXT. input	< +/- 5%	
* Bandwidth Amplitude @ input signal 6 div. 2 MHz	DC .... > 2 MHz	DC coupled
* Phase shift between X and Y-deflection	< 3^{o} @ 100 kHz	
* Dynamic range	> +/- 12 div. @ 100 kHz	
2.3.4 EXT input		
* Input impedance	1 M ohm +/- 2%	f_o < 1 MHz
Paralleled by	20 pF +/- 2 pF	f_o < 1 MHz
* Max. input voltage	400 V (d.c + a.c peak)	
Max. test voltage (rms)	500 V	Max. duration 60 sec.
* Lower - 3 dB point	< 10 Hz	AC coupled

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.4 TRIGGERING		
2.4.1 MTB triggering		
* Trig.mode AUTO (auto free run)	Bright line in absence of trigger signal	Auto free run starts 100 ms (typ.) after no trig.pulse.
Triggered Single		Switches automatically to auto free run if one of the display channels is grounded. In multi-channel mode (alternated) each channel is armed after reset; if sweep has already started, sweep is not finished.
* Trigger source A, B, Composite (AB), EXT, Line		Line trigger source always triggers on main frequency. Line trigger amplitude depends on line input voltage. Approx. 6 div. @ 220 VAC input voltage.
* Trigger coupling Peak-to-peak (p-p), DC, TVL, TVF		
* Level range Peak-to-peak	Related to peak-to-peak	p-p coupling is DC rejected.
DC INTERNAL DC EXTERNAL	> +/- 8 div. > +/- 800 mV	
TVL/TVF	Fixed level	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Trigger slope	+/-	Slope sign in LCD and + or - if TVL/F in chosen.
* Trigger sensitivity		
INTERNAL		
0 - 10 MHz	< 0,5 div.	Trig. coupling DC.
@ 50 MHz	< 1,0 div.	Trig. coupling DC.
@ 100 MHz	< 2,0 div.	Trig. coupling DC.
EXTERNAL		
0 - 10 MHz	< 50 mV	Trig. coupling DC.
@ 50 MHz	< 150 mV	Trig. coupling DC.
@ 100 MHz	< 500 mV	Trig. coupling DC.
TVL/F INTERNAL	< 0,7 div.	Sync. pulse.
EXTERNAL	< 70 mV	Sync. pulse.

2.4.2 DTB Triggering

* DTB trigger source Starts, A, B, Composite (AB) and TVL		TVL has same trig.source as MTB trig. source TVL only valid if MTB trig. coupling TVL or TVF is chosen.
* Coupling	DC	
* Trigger sensitivity	See MTB	
* Trigger Level range	> +/- 8 div.	
* Trigger slope	+/-	Slope sign in LCD, if TVL is chosen Slope sign is not valid.

2.5 POWER SUPPLY

* Line input voltage AC		One range.
Nominal	100 - 240 V	
Limits of operation	90 - 264 V	
* Line frequency		
Nominal	50 - 400 Hz	
Limits of operation	45 - 440 Hz	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Safety requirements within specification of : IEC 348 CLASS I UL 1244 VDE 0411 CSA 556 B		
* Power consumption (AC source)		
Typical (220 VAC)	45 W	Excl. accessories.
Maximum	< 50 W	Excl. accessories.

2.6 AUXILIARY INPUTS OR OUTPUTS

* Z-MOD		TTL-compatible.
ViH	> 2,0 V	Blanks display.
ViL	< 0,8 V	Max. intensity Analogue control between ViH and ViL is possible.
* DIN plug 9-pin (female)		For IEEE control, front-panel memory back-up.
* CAL		To calibrate drop or tilt probes.
Output voltage	1,2 V +/- 1%	Rectangular output pulse.
Frequency	2 kHz +/- 20%	
The output may be short-circuit to ground.		

2.7 ENVIRONMENTAL CHARACTERISTICS

The environmental data mentioned in this manual are based on the results of the manufacturer´s checking procedures.
Details on these procedures and failure criteria are supplied on request by the PHILIPS organisation in your country, or by PHILIPS, INDUSTRIAL AND ELECTRO-ACOUSTIC SYSTEMS DIVISION, EINDHOVEN, THE NETHERLANDS.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Meets environmental requirements of:	MIL-T-28800 C, type III, CLASS 5 Style D	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Temperature		
Operation temp. range within specification	10^{o} - 40^{o}C	MIL-T-28800 C par. 3.9.2.3. tested, par. 4.5.5.1.1.
Limits of operation temperature range	0 - 50^{o}C	Idem.
Non-operating (Storage)	- 40^{o}C/+ 75^{o}C	MIL-T-28800 C par. 3.9.2.3. tested, par. 4.5.5.1.1.
* Max. humidity		
operating	95% RH	
non-operating		
* Max. altitude		MIL-T-28800 C par. 3.9.3. tested, par. 4.5.5.2.
Operating	4,5 km (15000 feet)	Maximum (Operating Temperature derated 3^{o}C for each km ,for each 3000 feet, above sea level).
Non-operating (storage)	12 km (40 000 feet)	
* Vibration (operating)		MIL-T-28800 C par. 3.9.4.1. tested, par. 4.5.5.3.1.
Freq. 5...15 Hz	7 min.	
Sweep Time		
Excursion (p-p)	1,5 mm	
Max Acceleration	7 m/s^2 (0,7 x g)	@ 15 Hz
Freq. 15...25 Hz	3 min.	
Sweep Time		
Excursion (p-p)	1 mm	
Max Acceleration	13 m/s^2 (1,3 x g)	@ 25 Hz
Freq. 25...55 Hz	5 min.	
Sweep Time		
Excursion (p-p)	0,5 mm	
Max Acceleration	30 m/s^2 (3 x g)	@ 55 Hz
Resonance Dwell	10 min.	@ each resonance freq. (or @ 33 Hz if no resonance was found). Excursion, 9.7.1. to 9.7.2.
* Shock (operating)		MIL-T-28800 C par. 3.9.5.1. tested, par. 4.5.5.4.1.
Amount of shocks		
per axis	6	(3 in each direction).

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Bench handling		Mil-T-28800 C par. 3.9.5.3. tested, par. 4.5.5.4.3.
Meets requirements of	MIL-STD-810 method 516, proced. V	
* Salt Atmosphere		MIL-T-28800C par. 3.9.8.1 tested, par. 4.5.6.2.1.
Structural parts meet requirements of	MILT-STD-810 methode 509, proced. I salt solution 20%	
* EMI (Electronic Magnetic Interference) meets requirements of	MIL-STD-461 CLASS B	Applicable requirements of part 7 : CE03, CS01, CS02, CS06, RE02, RS03
	VDE 0871 and VDE 0875 Grenzwertklasse B	
* Magnetic Radiated Susceptibility Maximum Deflection Factor		Tested in conformity with IEC 351-1 par. 5.1.3.1. Measured with instrument in a homogeneous magnetic field (in any direction with respect to instrument) with a flux intensity (p-p value) of 1,42 mT (14,2 gauss) and of symmetrical sine-wave form with a frequency of 45...66Hz.

2.8 SAFETY

* Meets requirements of	IEC 348 CLASS I VDE 0411	Except for power cord, unless shipped with Universal European power plug.
	UL 1244 CSA 556 B	Except for power cord, unless shipped with North American power plug.
* Max. X-Radiation		Measured @ 5 cm from surface of instrument for a target area of 10 cm^2
* Recovery time	15 min.	-10^oC ----> + 25^oC ambient temp.
	30 min.	-20^oC ----> + 25^oC ambient temp.
	45 min.	-30^oC ----> + 25^oC ambient temp.
	60 min.	-40^oC ----> + 40^oC ambient temp.

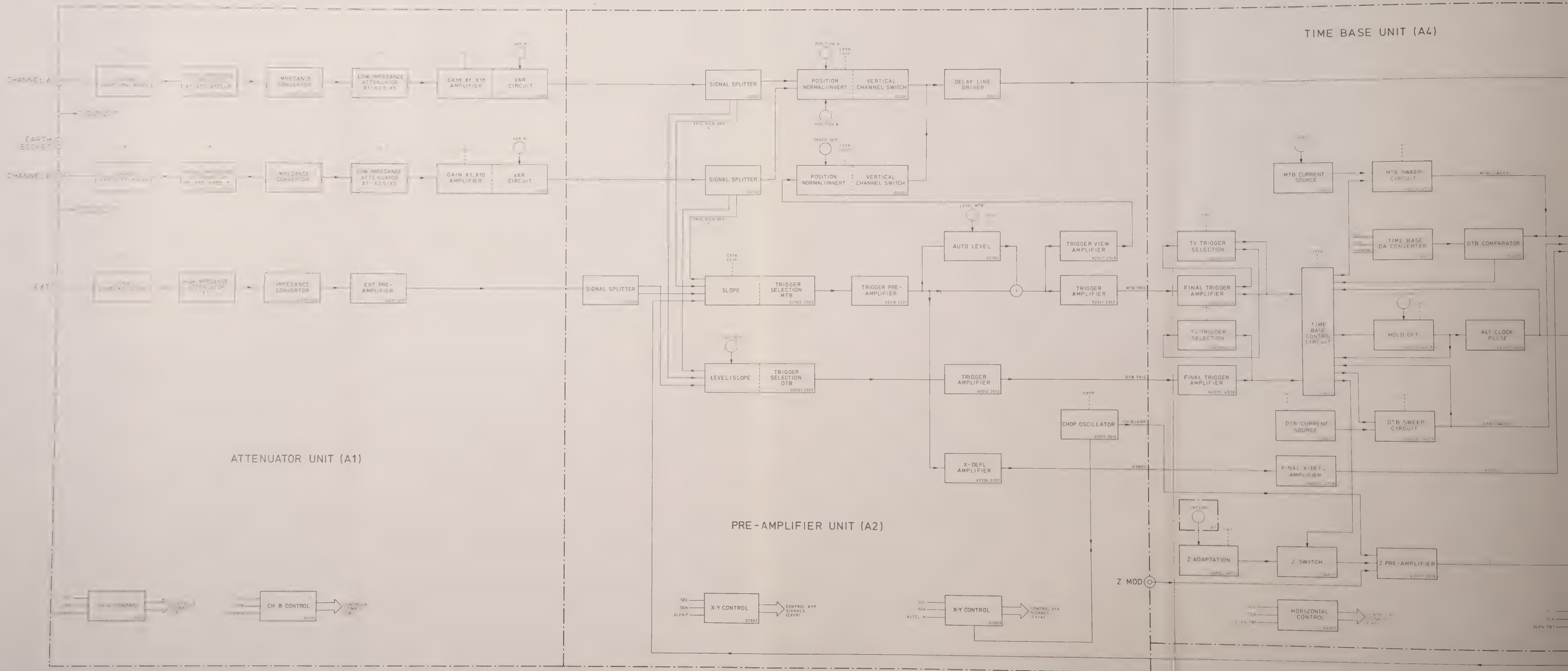
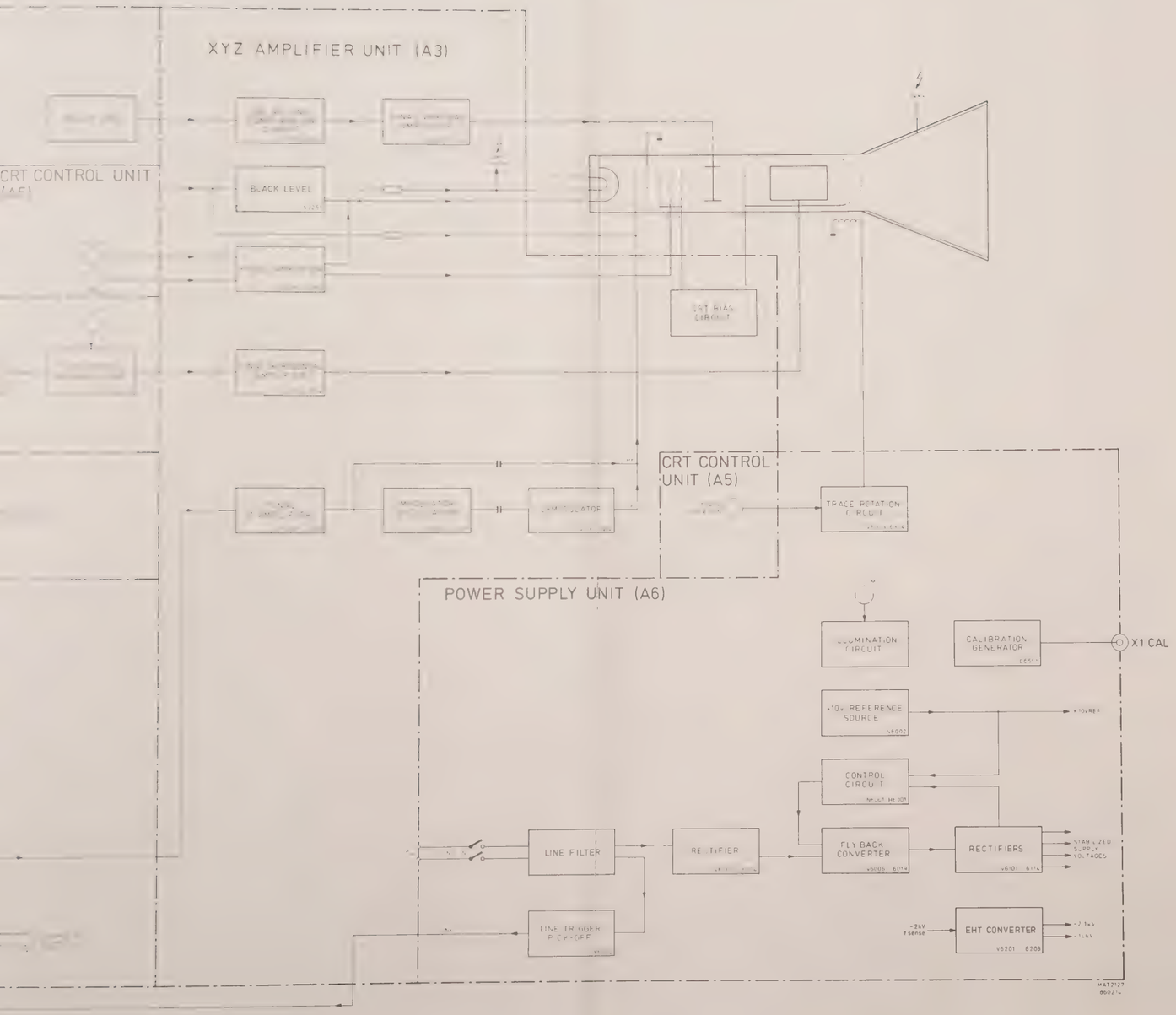


Figure 3.1 Block diagram



3.2 BLOCK DIAGRAM DESCRIPTION (see figure 3.1).

3.2.1 Introduction

This block diagram description is based around all the important functional blocks and their interconnections. The interconnections between all pcb's are given in the interconnection diagram of Fig. 14.5. In order to assist in cross-reference with the circuit diagrams, the blocks include the item numbers of the active components they contain.
Furthermore, the blocks are grouped together per printed-circuit board, or a part of it. To facilitate reference, the names of the functional blocks are given in text in CAPITALS.
Signal waveforms are also indicated at block interconnections where useful.
In this instrument almost all the switches (UP-DOWN controls, softkeys and potentiometer UNCAL switches) influence the oscilloscope circuits via a microcomputer (uC) system.

3.2.2 Control unit

Because the functional description of the control unit (see Chapter 10) is almost simular to the blockdiagram description, no specific attention is given in this Chapter to this unit.

3.2.3 Attenuator unit

The vertical channels A and B for the signals to be displayed are identical. Each channel comprises an input SIGNAL COUPLING for AC/DC, a HIGH IMPEDANCE ATTENUATOR which gives signal attenuation of x1-x10 or x100, an IMPEDANCE CONVERTER, a LOW IMPEDANCE ATTENUATOR which gives signal attenuation of x1-x2,5 or x5 and a GAIN x1-x10 AMPLIFIER block, incorporated with the CONTINUOUS CIRCUIT. This block has a variable gain, influenced by the front-panel VAR control. The gain is also increased by x10 in order to obtain 2-5 and 10mV settings.

Similar to the vertical channels, the external channel attenuator also has an input SIGNAL COUPLING, HIGH IMPEDANCE ATTENUATOR and IMPEDANCE CONVERTER in line. However, the external channel has only x1 attenuation and no LOW IMPEDANCE ATTENUATOR. The output of the external channel is fed to both MTB and DTB EXT PRE-AMPLIFIERS.

All blocks that are capable of working in different modes are controlled by the control A or control B signals. These signals are generated by the CH.A CONTROL or CH.B CONTROL blocks.

3.2.4 Pre-amplifier unit

This unit incorporates the signal splitters for the vertical channels A and B, the trigger view pre-amplifier, the trigger circuits for the MTB and DTB and the chopper oscillator circuit. All these functions are controlled by the control XYP and control XYA signals, generated by the X-Y CONTROL blocks.

* Vertical channels A and B:
Both channels are completely identical and receive their input signals from the ATTENUATOR UNIT. This signal is applied to the SIGNAL SPLITTER, which has three outputs:
- two outputs applied to the SLOPE/TRIGGER SELECTIONS for MTB or DTB triggering.
- a third output routed to the POSITION/NORMAL-INVERT block.

This block is incorporated with the VERTICAL CHANNEL SWITCH in a single IC. Vertical shift of the displayed signal is achieved by the front-panel POSITION control. The output of this block and the output of the TRIGGER VIEW channel are routed via the DELAY LINE DRIVER to the DELAY LINE.
The TRIGGER VIEW channel enables display of the MTB trigger source and can be used as a third vertical channel with limited specifications. The front-panel TRACE SEP control influences the position of the trace of the DTB signals related to the trace of the MTB signal.

* MTB trigger circuit:
The SLOPE/TRIGGER SELECTION block receives a trigger signal from one of the vertical channels A or B, from the EXT SIGNAL SPLITTER or from the LINE TRIGGER PICK-OFF.
Inverting of the trigger signal is controlled by the CXYA signals INVAM and INVBM to obtain the MTB slope function.
Routed via the TRIGGER PRE-AMPLIFIER, block the signal is split up into different paths:
- after summation of the LEVEL signal, direct to the TRIGGER AMPLIFIER
- to the AUTO LEVEL block. This block contains the different trigger facilities and levelling of the trigger signal is influenced by the front-panel LEVEL control. The output of this path is routed again to the summation point to influence the direct trigger signal.
- to the X-DEFL AMPLIFIER for X-deflection facility. This block incorporates a phase correction circuit for the X-Y display.

The TRIGGER AMPLIFIER feeds the MTB trigger signal to the time-base unit. The trigger signal from the summation point is also routed via the TRIGGER VIEW AMPLIFIER to the vertical CHANNEL SWITCH stage to display this signal.

* DTB trigger circuit:
Basically, for triggering purposes this circuit is identical to the MTB trigger circuit. This circuit also has a SLOPE/TRIGGER SELECTION and TRIGGER AMPLIFIER block. However, the DTB trigger circuit has no LINE trigger or AUTO LEVEL facility. The LEVEL control directly influences the SLOPE/TRIGGER SELECTION block.

* Chopper oscillator circuit:
A square-wave signal for chopper blanking and vertical switching is generated in the CHOP OSCILLATOR. For chopper blanking the signal is routed to the Z PRE-AMPLIFIER on the time-base unit.

3.2.5 Time-base unit

This unit incorporates the main time-base (MTB), the delayed time-base (DTB), the horizontal amplifier and the Z amplifier circuit. All functions are controlled by the CX1 and CX2 signals, generated by the HORIZONTAL CONTROL CIRCUIT blocks.

* Main time-base (MTB):
The MTB trigger signal can be either directly routed to the TIME-BASE CONTROL CIRCUIT or first routed via the TV TRIGGER SELECTION for the TV trigger coupling. When in the AUTO mode, in the absence of trigger signals, the MTB will be free running.

The MTB CURRENT SOURCE applies the sawtooth charging current to the MTB sweep circuit. This block generates the MTB sawtooth signal, which is routed to the HORIZONTAL DISPLAY MODE SWITCH..

The HOLD OFF and the ALT CLOCK PULSE blocks are also under control of the TIME BASE CONTROL CIRCUIT. Hold off time is varied by the front-panel HOLD OFF control. The output of the HOLD OFF block is routed to the TIME-BASE CONTROL CIRCUIT again.

The ALTCLN-pulse is applied to the PRE-AMPLIFIER UNIT.

3.2.6 XYZ unit

This unit comprises the final amplifiers for the vertical (Y) and horizontal (X) deflection and for the blanking (Z) circuit. In addition to this, the CRT control circuits are also incorporated in the unit.

* Final vertical amplifier:
The output signal from the pre-amplifier unit is first routed via the DELAY LINE to give sufficient delay to ensure that the steep leading edges of fast signals are displayed and then fed to the DELAY LINE COMPENSATION. This block compensates the signal for distortion originating in the DELAY LINE before it is applied to the FINAL VERTICAL AMPLIFIER. The output of the FINAL VERTICAL AMPLIFIER feeds the vertical deflection plates of the CRT.

* Final horizontal amplifier:
The horizontal deflection signal is routed to the FINAL HORIZONTAL AMPLIFIER, the output of which feeds the horizontal deflection plates of the CRT.

* Blanking circuit:
The output signal from the Z PRE-AMPLIFIER of the time-base unit, that determines trace blanking or unblanking and modulation is routed to the FINAL Z-AMPLIFIER. After amplification the blanking signal is split into two paths:
- the h.f. signals are fed via a high voltage capacitor to grid G1 of the CRT.
- the l.f. signals are used to modulate the amplitude of an oscillator wave-form, which then passes via another high voltage capacitor and is demodulated in the DEMODULATOR block to retrieve the original signal.

Note that the original h.f. and l.f. signals are again recombined on the grid G1.

* CRT control circuits:
The FOCUS AMPLIFIER block is influenced by both front-panel FOCUS and INTENS controls to provide a focus that is independent of the intensity, and drives the focusing grid G3 of the CRT.

The -100 V BLACK LEVEL block provides the correct presetting of the cathode voltage.

The CRT BIAS gives a d.c. voltage to the grids G4 and G5 to provide an optional adjustment for geometry and astigmatism.

3.2.7 Power supply unit

The mains input voltage is filtered and then applied to the RECTIFIER block to obtain a d.c. voltage source. Another output of the LINE FILTER block is routed via the LINE TRIGGER PICK-OFF and serves as a MTB LINE trigger signal. The rectified mains source is routed to the FLYBACK CONVERTER, which generates the necessary voltages for the oscilloscope circuits. Each supply voltage is rectified in the RECTIFIERS block.
The LOW-voltage supplies are stabilized by the CONTROL circuit to the converter.
The +10 V REF supply serves as a low-voltage reference and is generated in the +10 V REFERENCE source block. This reference voltage is also fed to the different circuits on the power supply or in the oscilloscope.

The EHT CONVERTER generates the -14 kV for the post-accelerator anode of the CRT and the -2 kV for the cathode circuits.

* Auxiliary circuits:
The CALIBRATION GENERATOR generates the CAL voltage, which is applied to the output socket X1. The CAL voltage has a 1,2 V p-p level with a frequency of 2kHz square wave.

The ILLUMINATION CIRCUIT determines the amount of current passed to the graticule illumination lamp of the CRT controlled by the ILLUM control on the front-panel.

The TRACE ROTATION CIRCUIT determines the strength and sense of the current passed to the trace rotation coil around the neck of the CRT. The current is influenced by the front-panel screwdriver operated TRACE ROT control.

4. ATTENUATOR UNIT (A1)

4.1 VERTICAL ATTENUATORS

The A and B channel attenuators are identical: therefore only channel A is described.

All relay and FET switches are controlled by the microcomputer via the I^2C bus. The TEA 1017 converts this serial DATA into the parallel control signals for all relay or FET switches. A list of the control lines for all attenuator settings is given in the table below.

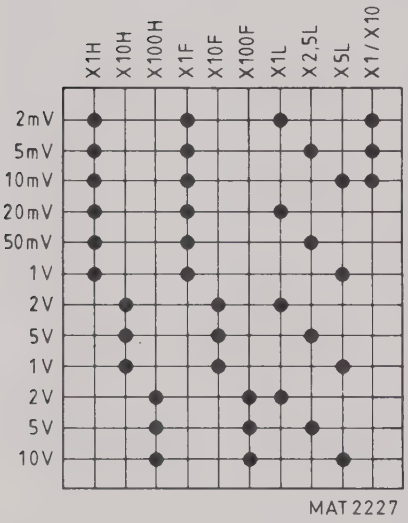


Fig. 4.1 Table of attenuator settings

The channel A attenuator consists of in five stages:

Input coupling , where depending on the relay K1001 position, the input signal can either be d.c.-coupled (relay activated) or a.c.-coupled (relay not activated).

High impedance attenuator with three attenuator stages for the x1, x10 and x100 attenuation. The 1.f. part of each stage is split via a resistor divider and routed via N1001 and V1019 to the output of this stage, where it is re-connected with the h.f. part of the input signal. Potentiometers R1036 (TRACE jump) serves as a offset compensation for N1001.

	RELAY	FET	TRIMMER FOR L.F. SQUARE WAVE	L.F. RESISTOR DIVIDER
x 1	K1004	V1011	C1033	--
x 10	K1003	V1006	C1029	R1007-R1011
x100	K1002	V1003	C1023	R1019-R1004

Note that, when "0" (GND-A) is selected, the output is connected to ground via FET V1016 and all other relay- and FET switches are switched off.

The impedance converter serves as an inverting buffer circuit for the high impedance attenuator. For the l.f.-feedback the output signal of this stage is routed to the l.f. summation point N1001-2.

The low impedance attenuator reduces the gain by x1, x2.5 and x5, depending on which relay is activated.

	RELAY	RESISTOR DIVIDER
x1	K1006	--
x2.5	K1007	R1053 vs R1056, R1057 and R1058
x5	K1008	R1053, R1056 and R1057 vs R1058

The continuous circuit (0Q0203), the differential input voltages of which are fed to pins 4 and 5.
This stage comprises the following functions:
- Continuously variable control (pin 11).
- Gain x1 (pin 2 and 3) with offset adjustment R1064 (R1164) and gain adjustment R1069 (R1169).
- Gain x10 (pin 6 and 7) with offset adjusting R1072 (R1172) and gain adjustment R1076 (R1176).
- x1/x10 control to select the 2,5 and 10 mV/DIV settings.

The differential output current from pin 13 and pin 14 is routed via a common-base circuit V1063, V1064 and applied to the pre-amplifier unit.

4.2 EXTERNAL INPUT

The external input can be subdivided into four stages:

Input coupling, basically similar to the ch.A input coupling.

High impedance attenuator for the x1 attenuator only, where the l.f. square-wave can be adjusted with trimmer C1206. The l.f. part is routed to the summation point N1201-2. R1217 serves as an offset compensation for N1201. For l.f.-feedback the output of the impedance converter is also routed to this summation point.
Note that the output of this stage is also a reconstituted version of the input signal.

Impedance converter, is basic similar to the ch.A impedance converter.

The differential amplifier V1211, V1212 converts the voltage from emitter-follower V1209 into the differential current signals EXT+ and EXT-. This signal is applied to the pre-amplifier unit and serves as external trigger signal or as an external deflection signal.
The current for this stage is applied from current source V1213.

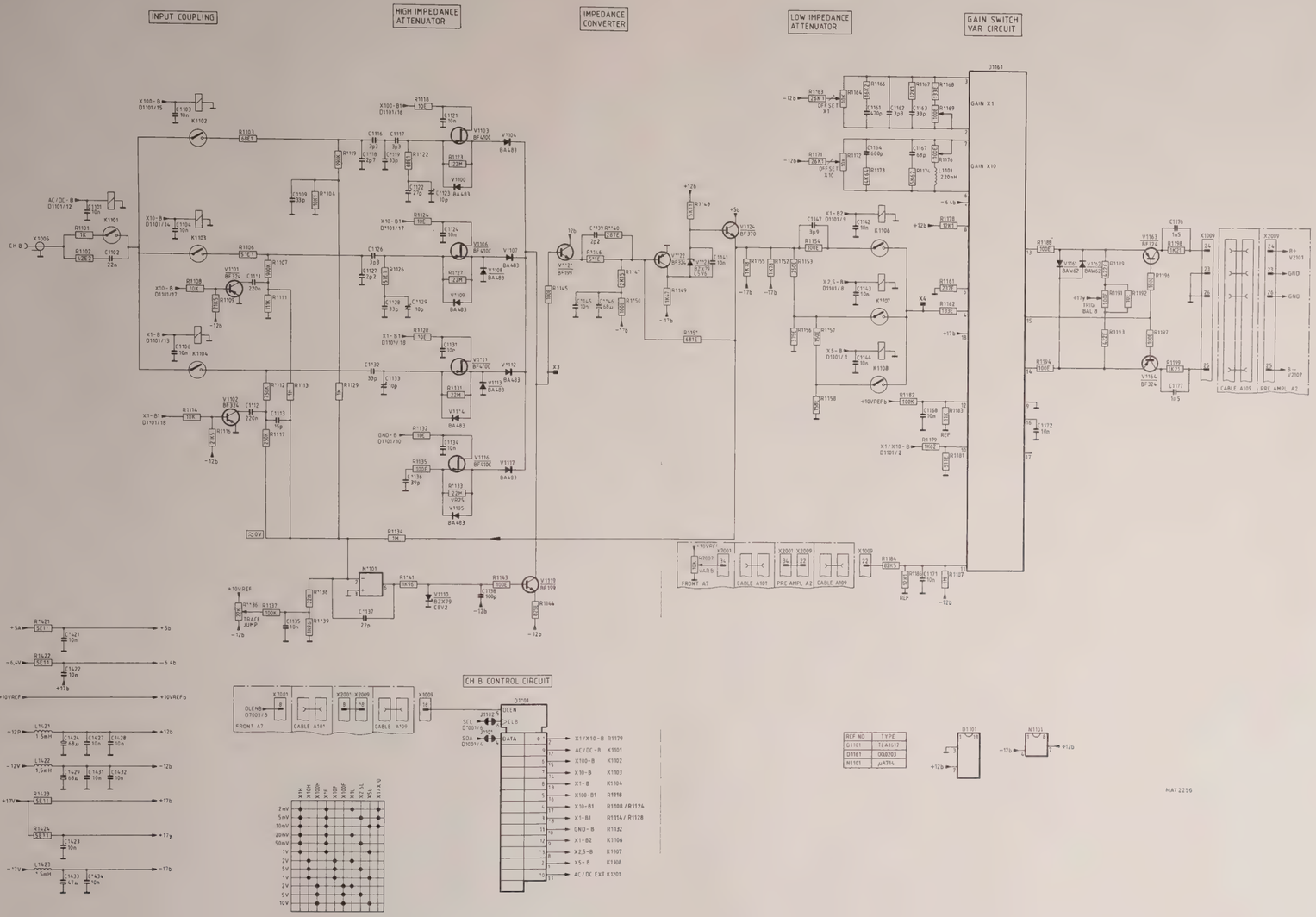


Figure 4.4 Circuit diagram of Attenuator, ch. B

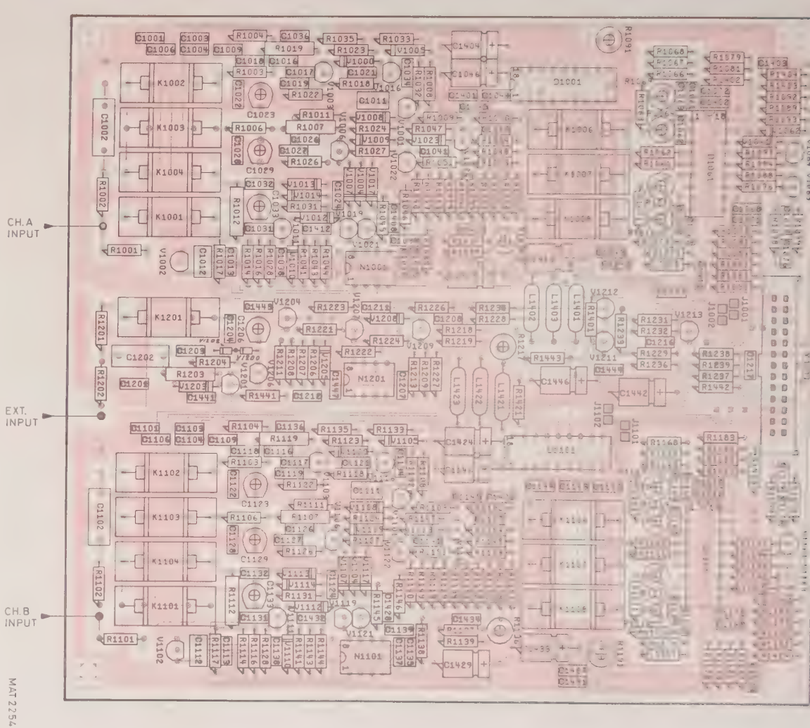


Figure 4.5 Attenuator unit pcb

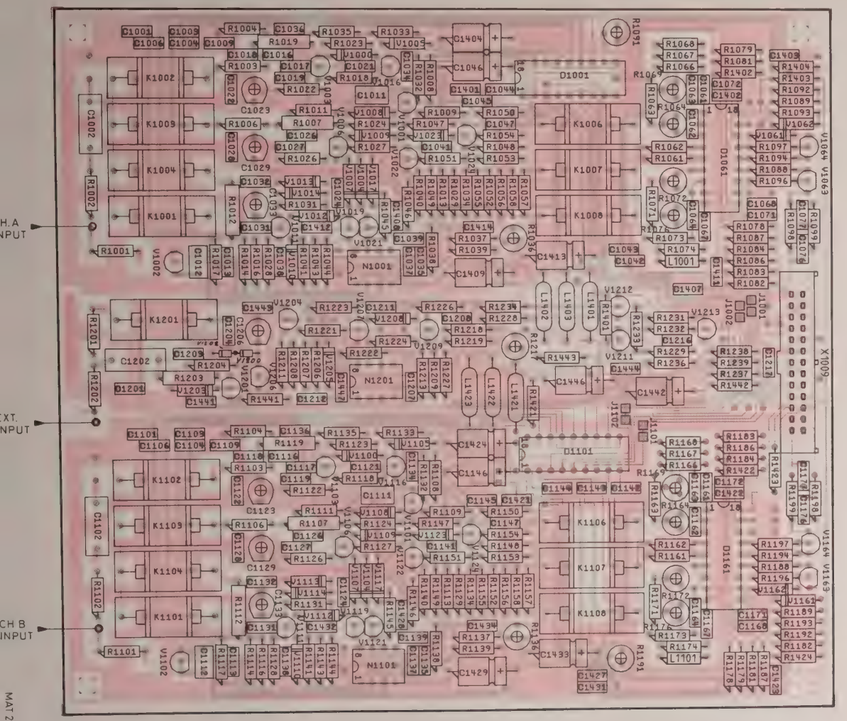


Figure 4.2 Attenuator unit pcb

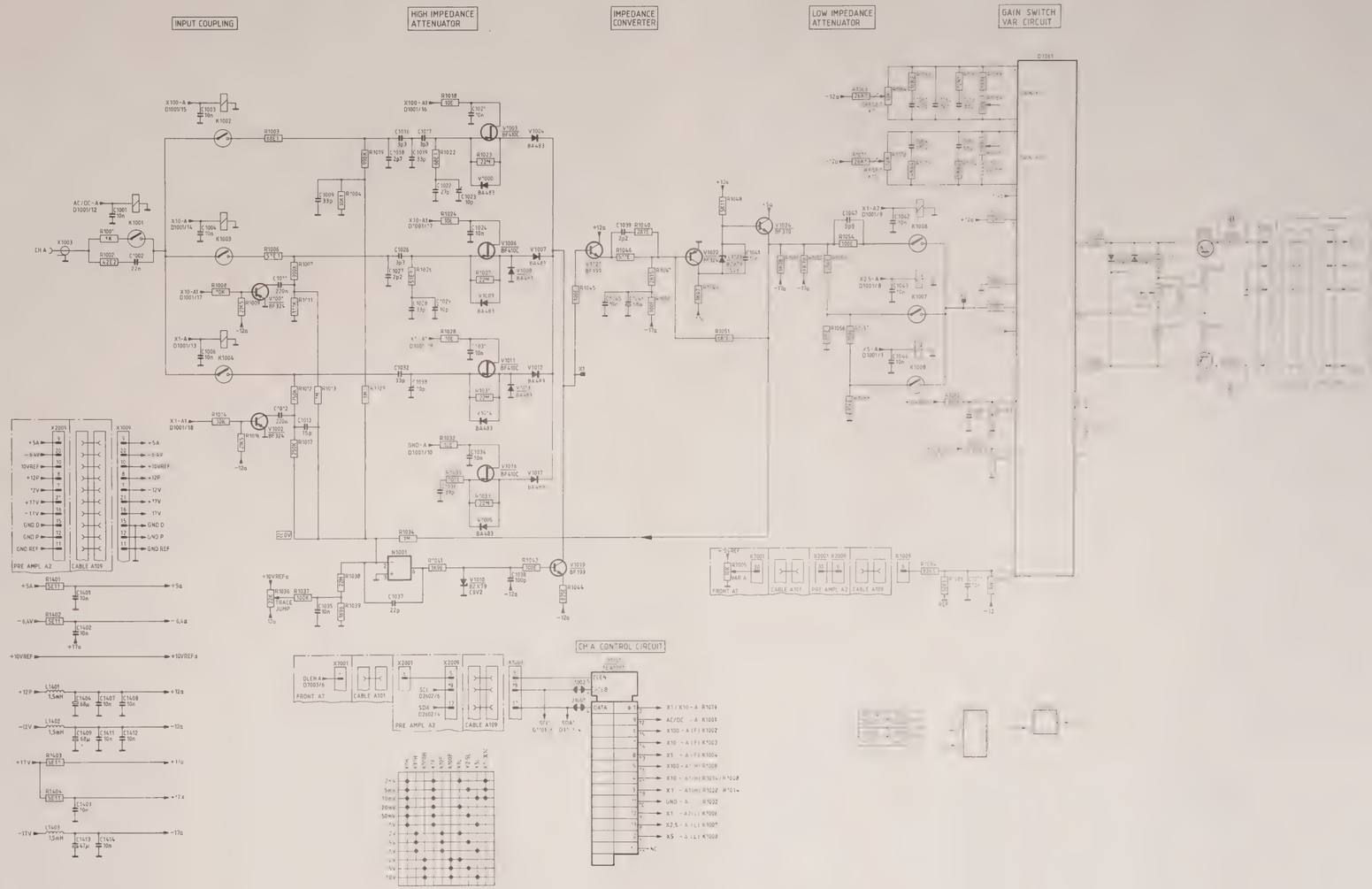
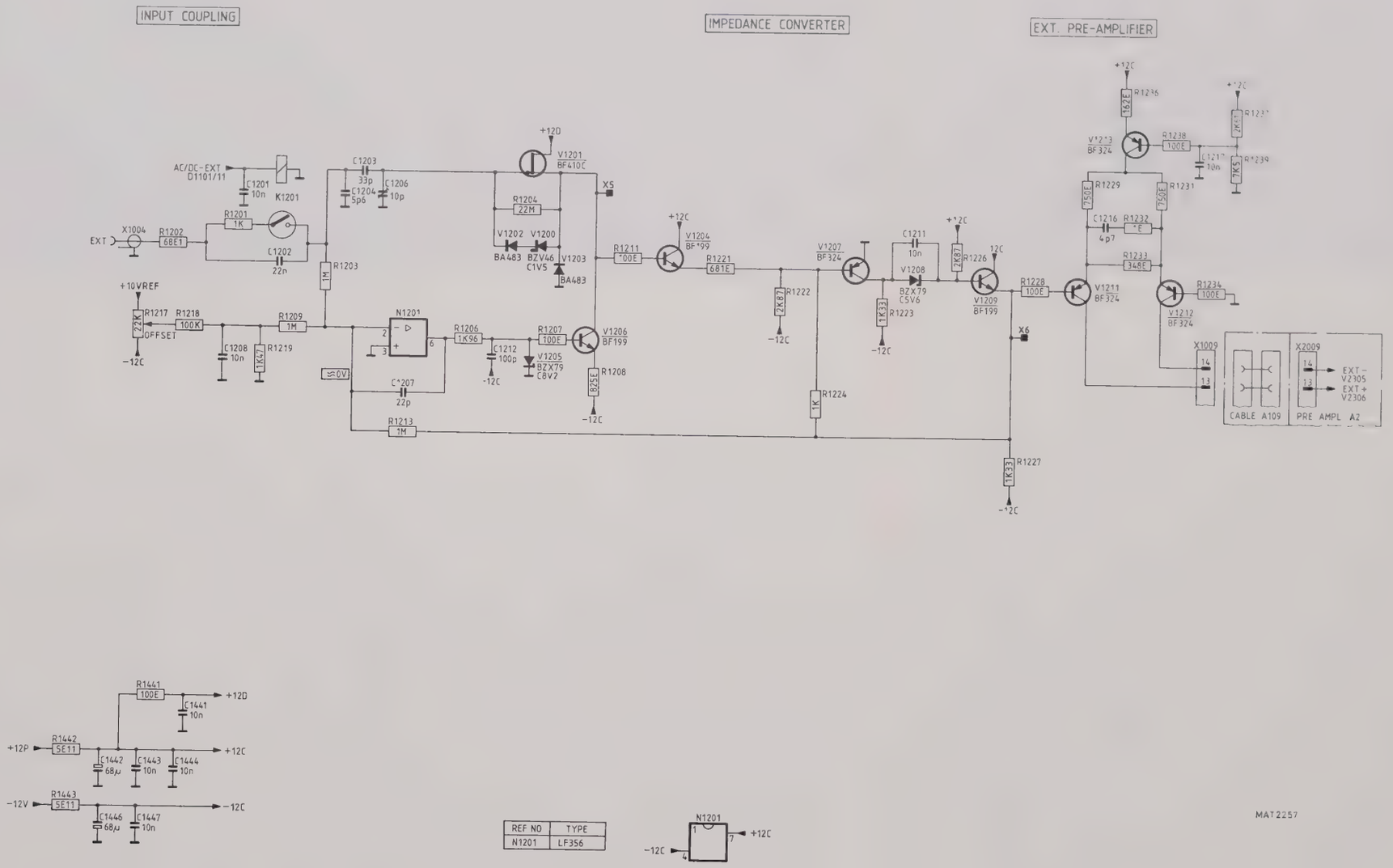


Figure 4.3 Circuit diagram of Attenuator, ch. A



REF NO	TYPE
N1201	LF356

Figure 4.6 Circuit diagram of Attenuator, EXT.

5. PRE–AMPLIFIER UNIT (A2)

The pre-amplifier unit consists of:
- Vertical pre-amplifier
- MTB trigger pre-amplifier
- DTB trigger pre-amplifier
- Pre-amplifier control, incl. CHOPPER oscillator.

All control pulses for this unit are generated by the pre-amplifier control circuit, via the I^2C bus (see Section 5.4).

5.1 VERTICAL PRE-AMPLIFIER

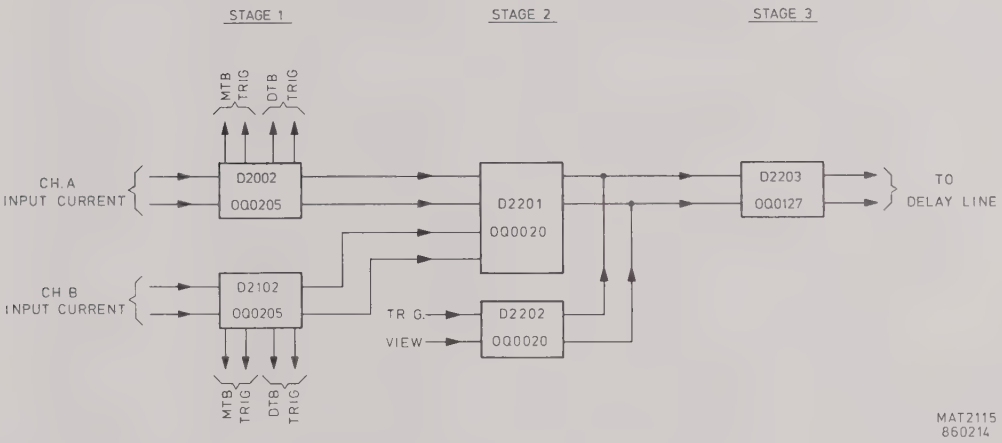


Fig. 5.1 The three stages of the vertical pre-amplifier

The vertical pre-amplifier consists of three stages.

The signal splitter (Q0205) receives its input signal for channel A (B) from the attenuator unit and copies this signal into three identical differential output current signals for:

- Vertical channel (pin 7 and 10)
- MTB triggering (pin 5 and 12), see Section 5.2.
- DTB triggering (pin 4 and 13), see Section 5.3.

Stage 2 (OQ0020) consists of two integrated circuits D2201 and D2202, connected in parallel and serves as a vertical channel switch. The switch selection is as follows:

	D2201		D2202
	pin 10	pin 11	pin 10
A	1	0	0
B	0	1	0
TRIG VIEW	0	0	1
ADD	1	1	0

Further, all possible 2, 3, or 4 channel combinations are possible in alternated or chopped display (see also Section 5.4).

This stage comprises the following functions:
- Position control POS A R7006 on D2201-1 for ch. A and POS B R7008 on D2201-8 for ch. B.
- Channel B normal/invert (high is INVERT) on D2201-11. (The balance between normal/invert can be adjusted with R2212).
- Trigger view invert (high is INVERT) on D2202-2.
- Trace separation control with R7013 on D2202-8.

Stage 3 (D2203) serves as delay line driver where the output current of both OQ0020 is converted into voltage signal applied to the delay line. The current for this stage and for D2201 and D2202 is fed via R2231 and R2246.
The current regulation for the common-mode circuit is achieved by transistor D2203 (12, 13, 14).

5.2 MTB TRIGGER PRE-AMPLIFIER

Trigger possibilities are:

	Signal		Selected by:		inverted by:	
	name	routed to	name	routed to	name	routed to
ch. A	TRAM+, TRAM-	D2302(3,4)	AM	D2302(10)	INVAM	D2302(2)
ch. B	TRBM+, TRBM-	D2302(5,6)	BM	D2302(11)	INVBM	D2302(7)
EXTERNAL	EXT-, EXT+	D2303(3,4)	EXTM	D2303(10)	INVAM	D2303(2)
line	LINE	D2303(5)	LNM	D2303(11)	INVAM	D2303(7)

D2301 serves as a signal splitter and receives its input signal from the attenuator unit. This input current signal is copied into two identical differential output current signals for:
- EXT MTB signal (pin 6 and 11)
- EXT DTB signal (pin 7 and 10), (see Section 5.3).

The symmetrical output currents from D2302 (13, 14) and D2303 (13, 14) are converted into a symmetrical voltage again in the common-base circuit V2316, V2319 followed by a shunt feedback circuit V2318 and V2321. Note that the sensitivity at the collectors of V2318 and V2321 is 110 mV/DIV.

At this point the signal path is divided into:
- a trigger path, fed to both V2333 and V2334, where depending on the current to the base, levelling of the trigger signal is obtained. Two separate series feedback circuits take care of voltage-to-current conversion:

* V2341 and V2342 for main time-base triggering.
  The trigger output signal, TRIGM- and TRIGM+ are fed to the time-base unit A4.
* V2347 and V2349 for trigger view.
  This symmetrical output can be balanced by potentiometer R2407 (Trig view BAL).
  The TRIGV+ and TRIGV- signals are fed to D2202 (3-4).

Integrated circuit D2304 serves as an auto level circuit. The following functions are possible.

a. Peak-peak
   In this case the amplitude of the trigger signal applied to D2304 (3,7) is measured by peak-peak detectors on D2304 (2,4,6,8). The output current from D2304 (14,15) is dependent on the peak-peak level and is adjustable with the LEVEL control R7012, connected to D2304(1).
b. triggering
   In this case the level range is 16 div. The level is adjustable with R7012 and the current variation on D2304 (14,15) can be varied between +or- 0,6mA.
c. TV triggering
   The level control is made ineffective. In TV triggering, the LEVEL must be set to a fixed value. This is done by applying a high level current to pin 1 via diode V2326.
d. auto
   In auto the signal LEVEL ZERO is high and via diode V2325 the output level D2304 (15) is asymmetrical with output level D2304 (14). Thus the maximum signal amplitude is 2 Vp-p.

- an external deflection path, routed via the series feedback circuit V2356 and V2357, the X DEFL+ and X DEFL- signals are fed to the time base unit A2.
  R2416, R2422 and C2350 gives phase correction for the X-Y display.

5.3 DTB TRIGGER PRE-AMPLIFIER

Trigger possibilities are:

	Signal		Selected by:		Inverted by:	
	name	routed to	name	routed to	name	routed to
ch.A	TRAD+, TRAD-	D2501(3,4)	AD	D2501(10)	INVAD	D2501(2)
ch.B	TRBD+, TRBD-	D2501(5,6)	BD	D2501(11)	INVBD	D2501(7)
EXTERNAL	EXT+, EXT-	D2502(5,6)	EXTD	D2502(11)	INVAD	D2502(7)

Similar to the main time base triggering, signal splitter D2301 applies the EXT current to the OQ0020.

The LEVEL control R7014 is connected to D2502-1 to obtain a level range of 16 div.

The output of both integrated circuits, pin 13 and 14, are routed via a shunt feedback V2512, V2513, followed by a series feedback circuit V2514, V2516 and provide the DTB trigger signals TRIGD- and TRIGD +. These signals are fed to the time-base unit A4.

5.4 PRE-AMPLIFIER CONTROL

The pre-amplifier control converts the data from the 1^2C bus (SDA and SCL), derived from the microcomputer, into the control pulses for the pre-amplifier unit. To eliminate interference the SDA and SCL lines can be switched off via D2601.

This integrated circuit serves as a digital switch, controlled by the VERT IIC line. Logic high connects the outputs D2601(4,14,15) to the input "1" contact (switched on); logic low connects the outputs to the "2" contact (switched off) and gives SDA a logic low level and SCL a logic high level.

When D2601 is switched on, the serial data information is converted into parallel control pulses via D2602 and D2603, provided that D2602 is enabled (D2602-5 is high). The control lines are active when the level of the line is high.

Output Q12-D2602(9) serves as a power up not line for D2603: when the oscilloscope is in the power-up routine, Q12 is high and resets D2603. After the power-up routine, Q12 goes low and enables D2603.

Integrated circuit D2603 relieves the microcomputer of a number of such functions as:
- trigger view
- chop/alt
- trace separation
- trigger select
- time-base select (fed to time base unit A4)

Adaptation of this I.C. to the oscilloscope version is made by the AD0 and AD1 inputs D2603(15,16).
For this oscilloscope, AD0 must be HIGH and AD1 must be LOW.

Timing for alternate and chopped mode is derived by the ALTCLN and CHOPCL pulses.

The chopper oscillator formed by V2611 and V2612 supplies a square wave voltage of 1,5 Vp-p with a frequency of 1 MHz.

This frequency is defined by two current loops:
- I1 is determined by: V2612(c-e), C2611, R2627 and R2625.
- I2 is determined by: V2611(c-e), C2611, R2628 and R2625.
The duty cycle (I1/I1+I2) is 12% approx.

The square wave on the collector of V2612 serves as a chopper clock pulse for D2603 and gives a 500 kHz display for 2 channels CHOP, 333 kHz display for 3 channels CHOP and 250 kHz for 4 channels CHOP (A-B-TRIG VIEW-ADD).

Note that D2603(8) serves as the chopper switch, which is high when the CHOP softkey is depressed.

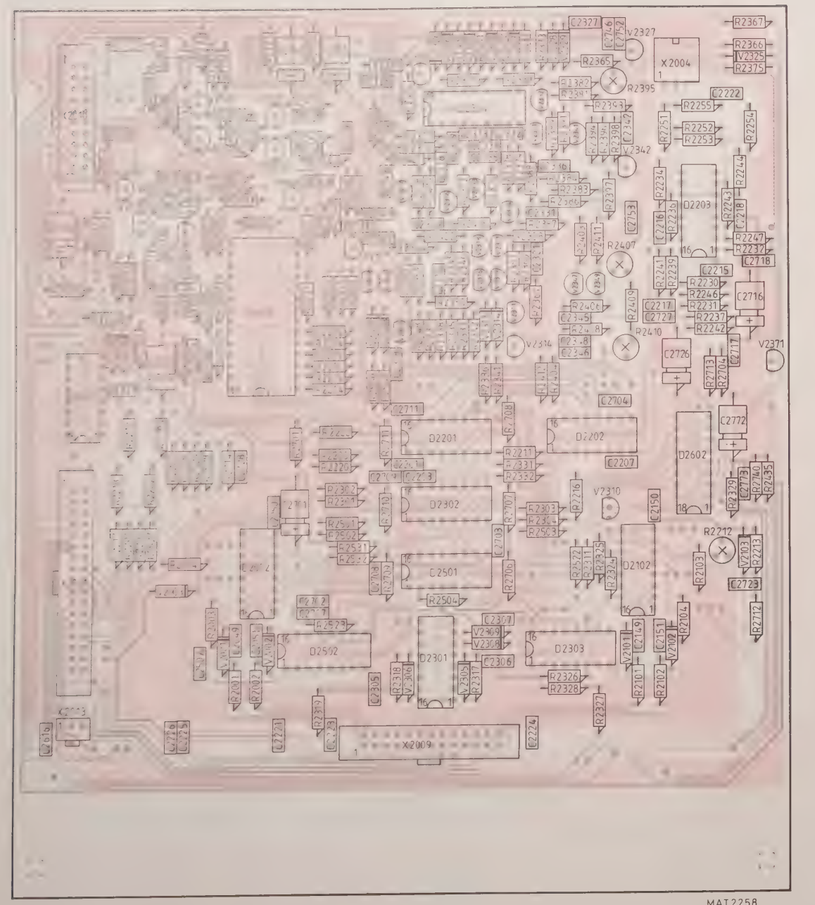
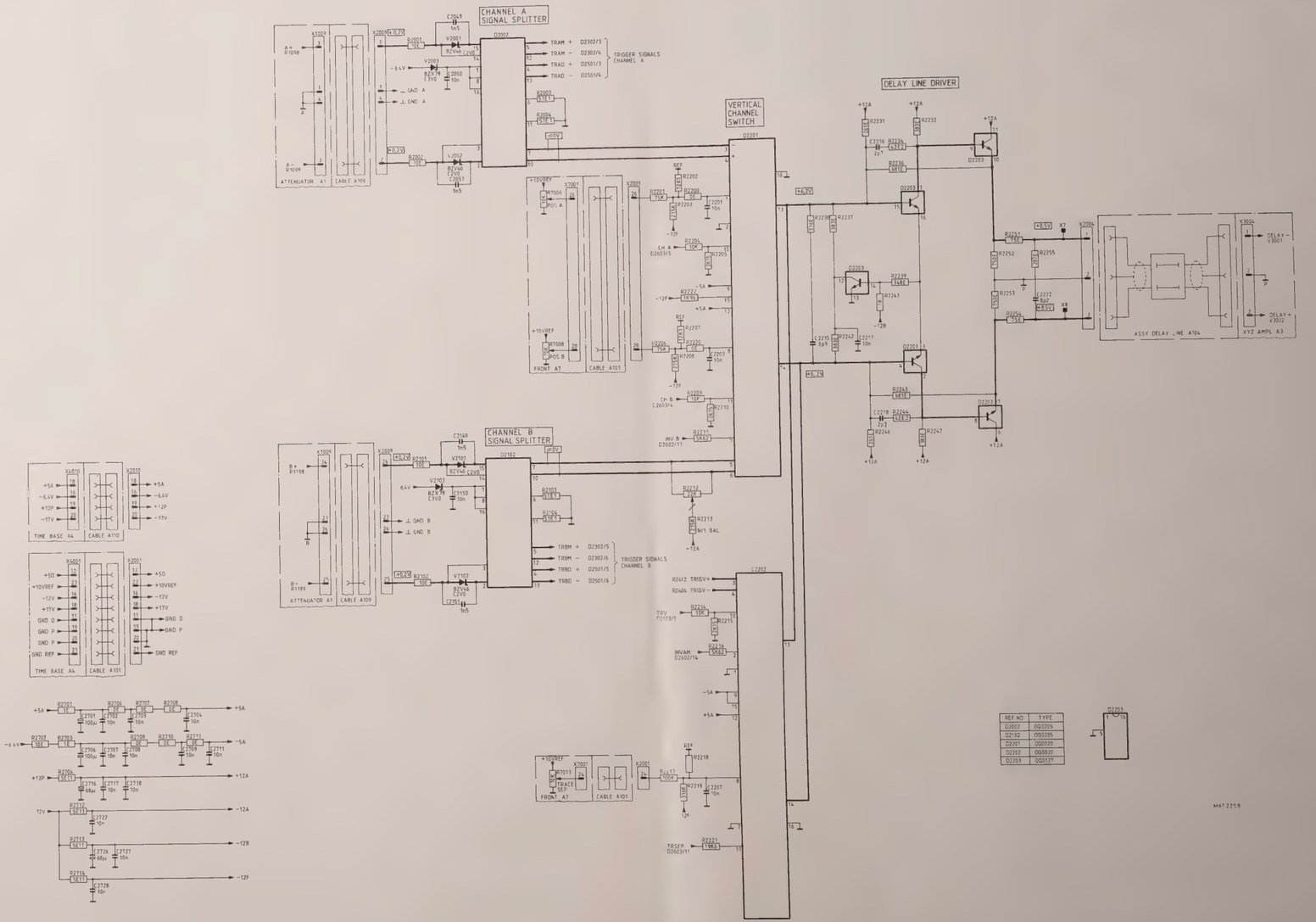
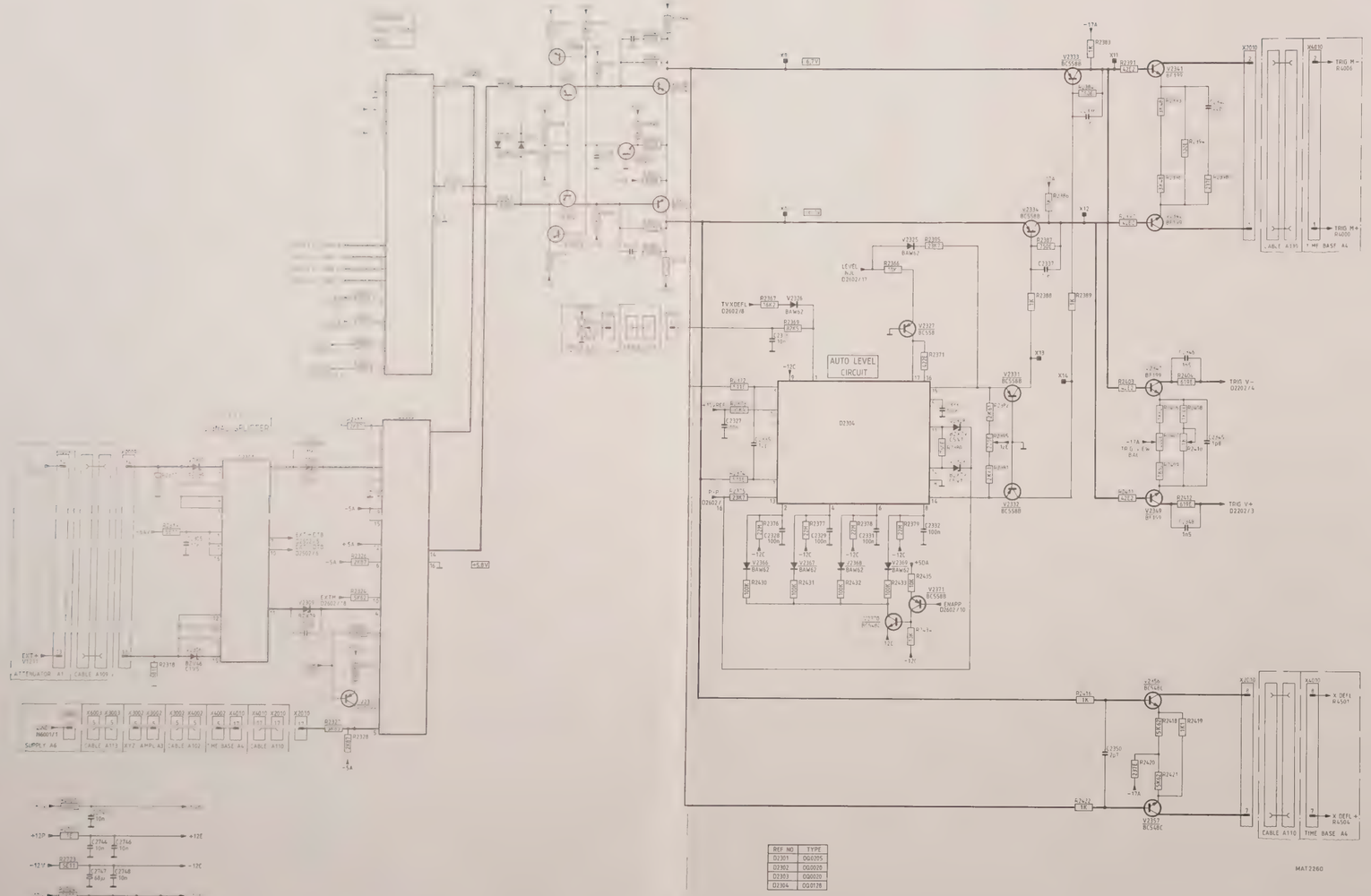


Figure 5.2 Pre-amplifier unit pcb



REF NO	TYPE
D2002	0Q2705
D2102	0Q0205
D2201	0Q0020
D2202	0Q0070
D2203	0Q0127

Figure 5.3 Circuit diagram of Pre-amplifier, channel switch + delay line driver



REF NO	TYPE
D2301	OQ0205
D2302	OQ0020
D2303	OQ0030
D2304	OQ0178

Figure 5.4 Circuit diagram of Pre-amplifier, MTB trigger switch

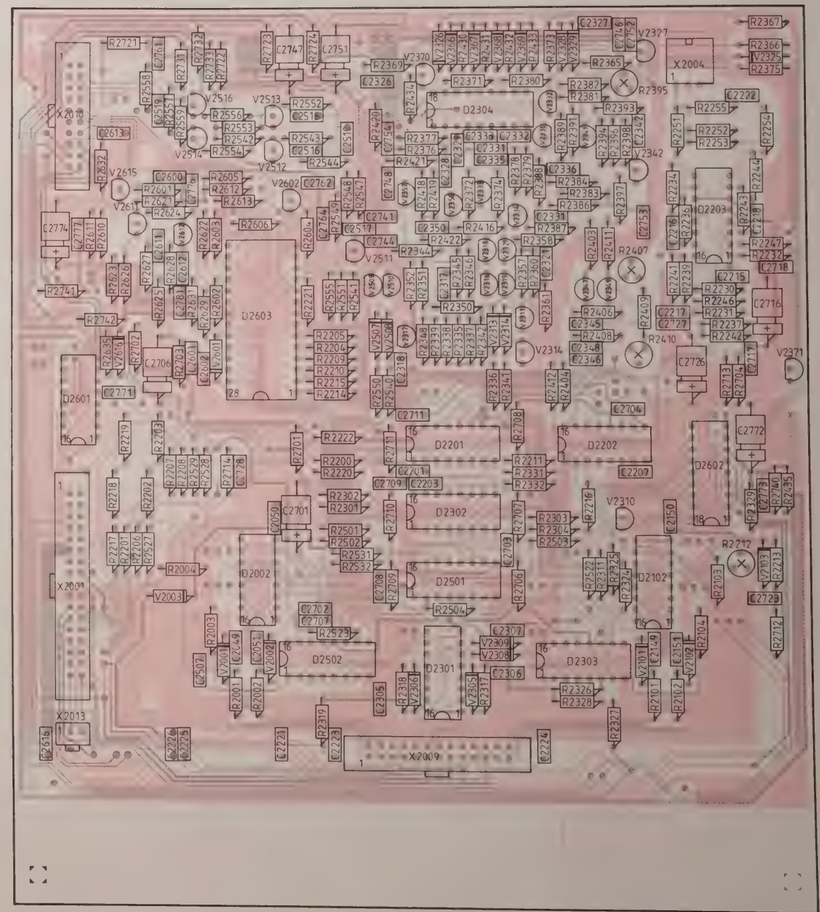
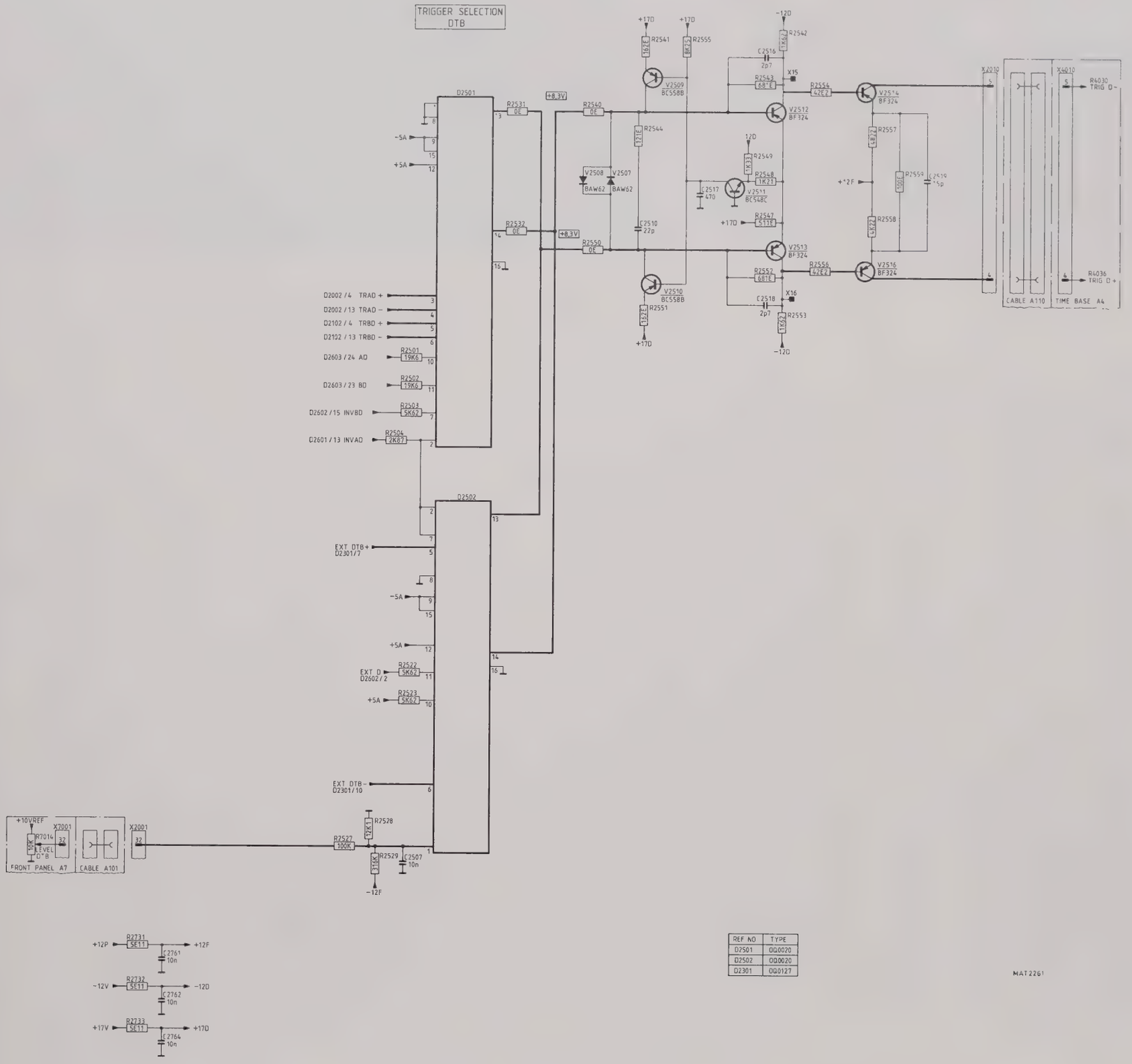


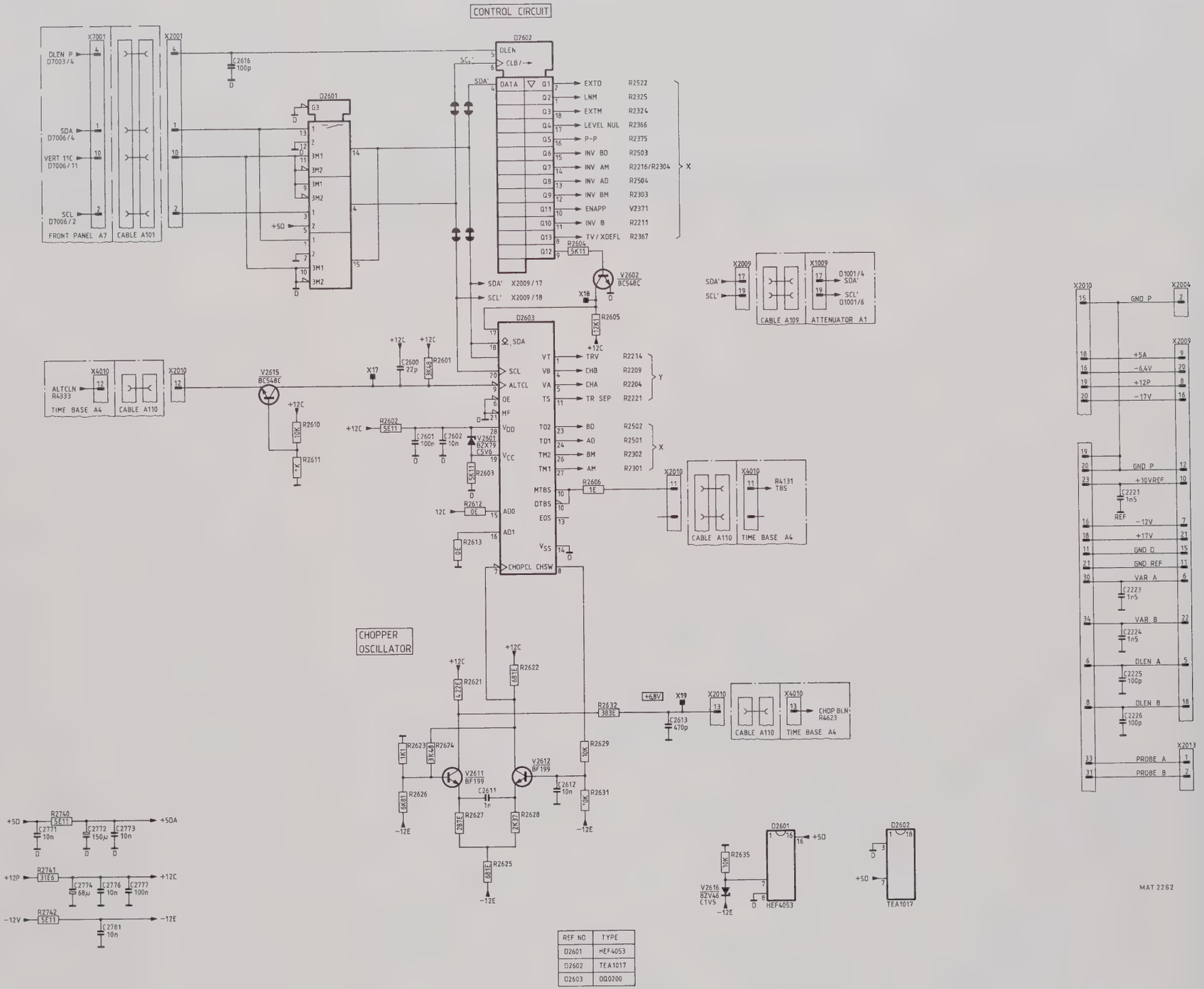
Figure 5.5 Pre-amplifier unit pcb



REF NO	TYPE
D2501	OQ0020
D2502	OQ0020
D2301	OQ0127

MAT2261

Figure 5.6 Circuit diagram of Pre-amplifier, DTB trigger switch



REF NO	TYPE
D2601	HEF4053
D2602	TEA1017
D2603	0Q0200

Figure 5.7 Circuit diagram of Pre-amplifier, logic control

6. XYZ–AMPLIFIER UNIT (A3)

6.1 INTRODUCTION

Unit A3 incorporates two separate pcb´s which are connected via X3001. One pcb includes among other things the CRT socket and is connected at the rear of the CRT. The other pcb comprising the proper final X and Z amplifiers is situated at the upper side of the CRT. For ease of description, unit A3 is described as one unit.

The XYZ-amplifier unit consists of:
- Final vertical (Y) amplifier.
- Final horizontal (X) amplifier.
- Final unblanking (Z) amplifier, incl. CRT.

6.2. FINAL VERTICAL (Y) AMPLIFIER.

The final Y-amplifier receives its signal from the delay line and supplies the correct vertical signal to the Y-deflection plates of the CRT.
For this the signal is processed in four stages:
- V3001, V3002 as a series feedback amplifier, including a delay line compensation network and potentiometer R3007 controlling current source V3003 for correction of any unbalance in the Y-deflection plates of the CRT. These circuits are connected between the emitters of both transistors.
  In this stage the input voltage is converted into a current signal.
- V3004, V3006 as a shunt feedback amplifier, which gives a voltage signal to the next stage.
- V3008, V3009 as a series feedback amplifier, including a final RC-correction network and potentiometer R3038 for gain adjustment to compensate the different CRT sensitivities. V3007 supplies a constant current of 60 mA, i.e. 30 mA for each side. Note that the output again supplies a current signal.
- V3011, V3012 as a common-base amplifier for buffering the final Y-amplifier to the Y-deflection plates. The maximum amplitude on each deflection plate is: 30 mA x 655 E = 20 V approx.

6.3. FINAL HORIZONTAL (X) AMPLIFIER

The input current for X-deflection is obtained from the time-base unit (ref: X- and X+) and processed in three stages, with circuits in the following configurations:

- V3101, V3102 as a common-base amplifier. The current "I" on the collector of both transistors determines the voltage across R3102 and R3116. This voltage is about 1,5 V p-p and feeds the next stage.

- V3103, V3106 as a series feedback amplifier, including a RC-correction network for optimum linearity of the trace andpotentiometer R3118 for xl amplifier adjustment, mounted between the emitters of both transistors. V3104 serves as current source.

- V3112, V3114 are connected as a shunt feedback amplifier, with resistors R3126 and R3134 as the feedback resistors. The transistor source are emitter followers V3109, V3111. This circuit serves as the actual final amplifier, which converts the deflection current into the proper deflection voltage for the X-deflection plates of the CRT. Transistors V3108, V3116 supply the bias current for the circuit.

6.4 FINAL BLANKING (Z) AMPLIFIER AND CRT

The blanking current derived from the Z pre-amplifier of the time-base unit is routed via common base amplifier V3200 and emitter-follower V3201 to the shunt-feedback amplifier V3202. This stage is fed by current source V3203, which gives a constant current of 4 mA. The voltage on the collector of V3202 can vary between +5 V for unblanking and -35 V for fully blanking.
This Z-pulse may contain d.c., l.f. and h.f. components to be applied to grid G1 of the CRT. Since G1 is at a cathode potential of -2000 V, blocking capacitors are required between G1 and the Z-amplifier output. The h.f. component is directly routed via blocking capacitor C3211 to G1.
However, the d.c. and l.f. components are blocked, so these components are first modulated on a 200 kHz carrier signal by V3207 and V3208 to pass blocking capacitor C3209. Then the signal is demodulated again by V3209 and V3211. Finally, the reconstituted d.c. and l.f. components are added to the h.f. component.

Transistor V3251 forms a nominal 70 V zener circuit which provides the voltage difference between the cathode and G1 of the CRT. This bias voltage ensures blanking when there is no input signal. For adaptation to each CRT, this voltage can be varied between about 40 V and 100 V by means of R3252 (BLACK LEVEL). Resistor R3254 maintains the filament at the same potential as the cathode.

Any ripple on the cathode voltage is fed-back via transistor V3213 to the input of the Final Z-amplifier and added to the blanking signal. This means that the differential voltage between G1 and the cathode of the CRT is always fixed. Because this differential voltage determines the intensity of the spot, as a result, the intensity is almost independent of the ripple.

The amplifier stage V3253, V3254 and V3256 provides amplification for the range of the FOCUS control. The range of 0...+10 V gives a final range on G3 of the CRT of -1350 V ... -1600 V.

Resistor R3257 connects the INTENS control to the focus adjustment to maintain a sharply defined trace at varying brightness.

For optimum presetting of the GEOMETRY, the voltage on G5 of the CRT is set to a fixed level of -30 V. The ASTIGMATISM can be varied by means of potentiometer R3267.

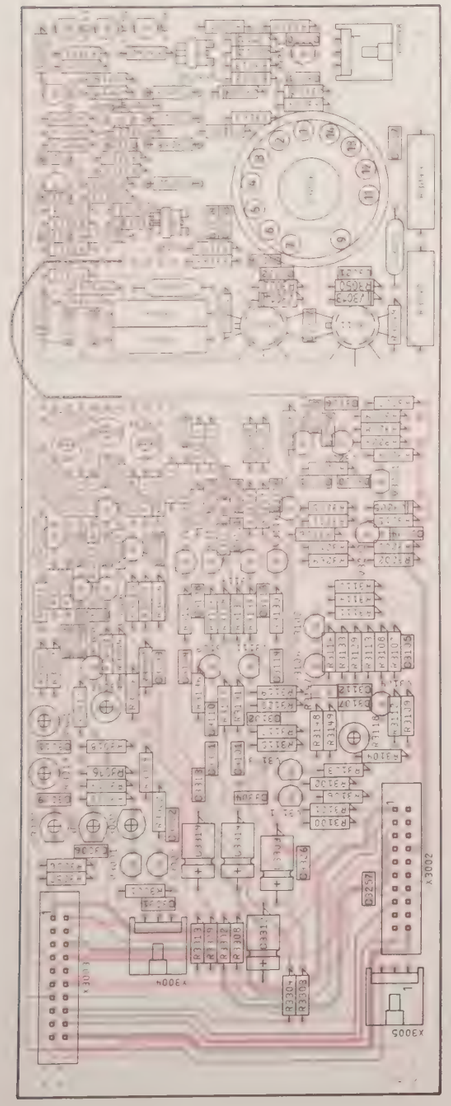
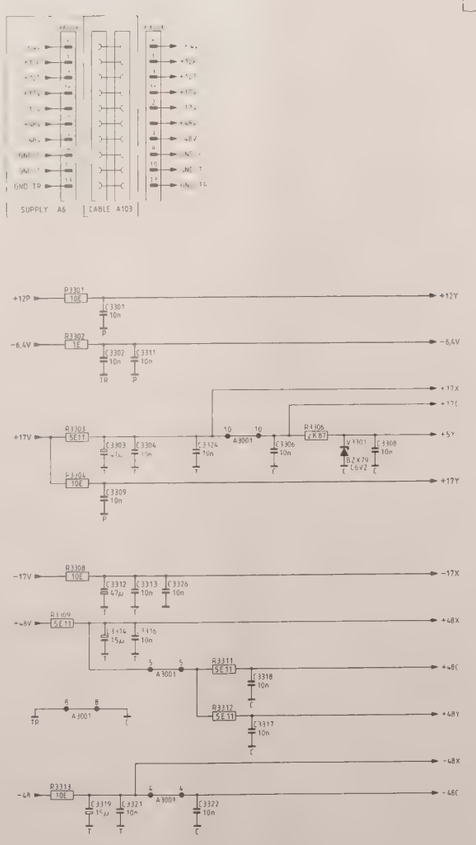
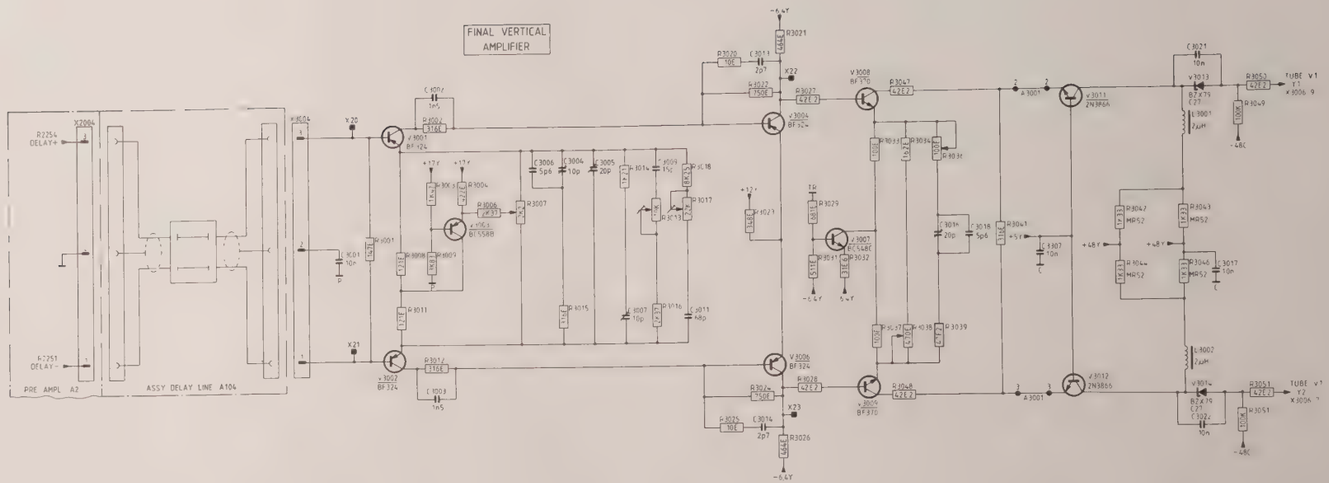


Figure 6.1 XYZ Amplifier unit pcb





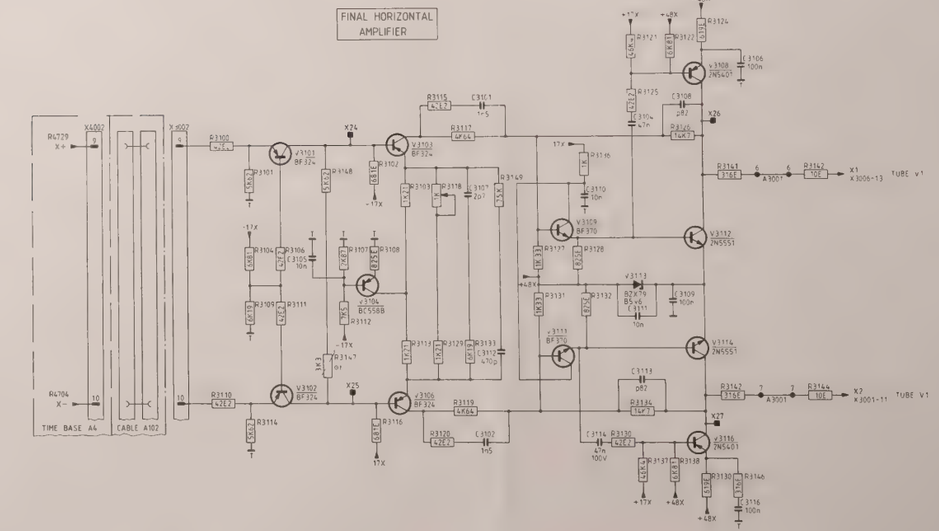


Figure 6.2 Circuit diagram of XYZ Amplifier, Final X and Y amplifiers

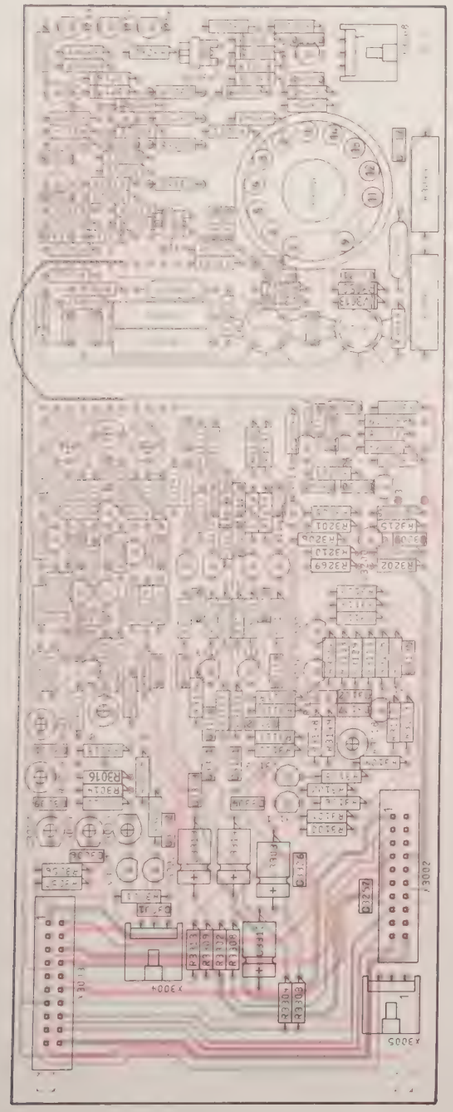
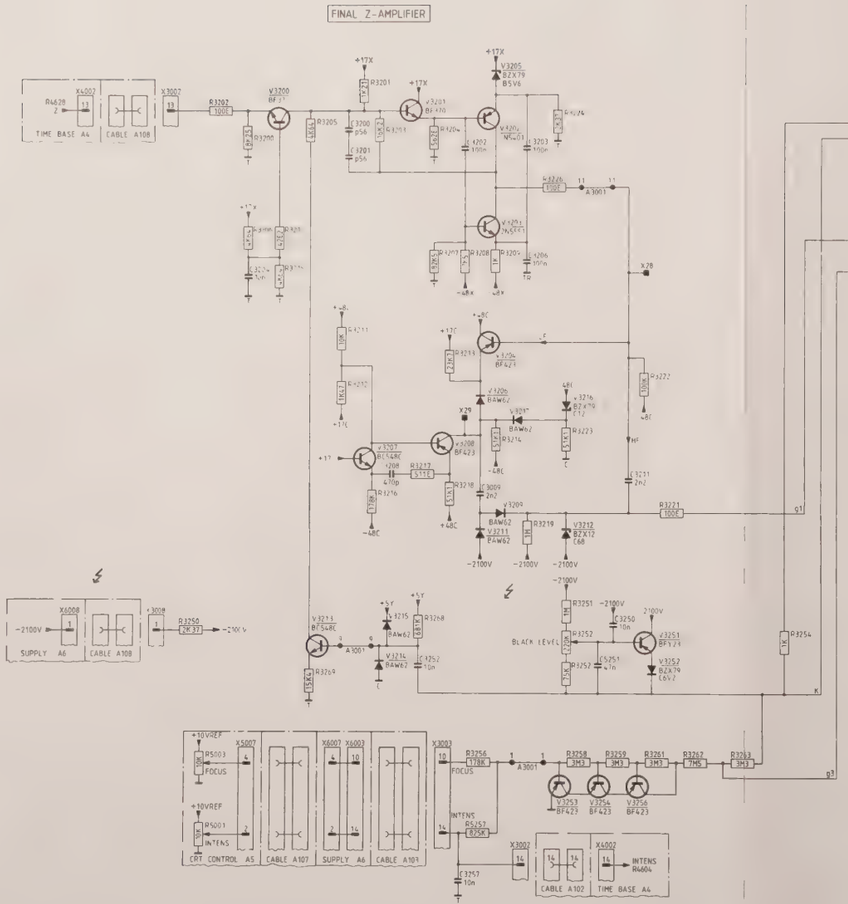


Figure 6.3 XYZ Amplifier unit pcb



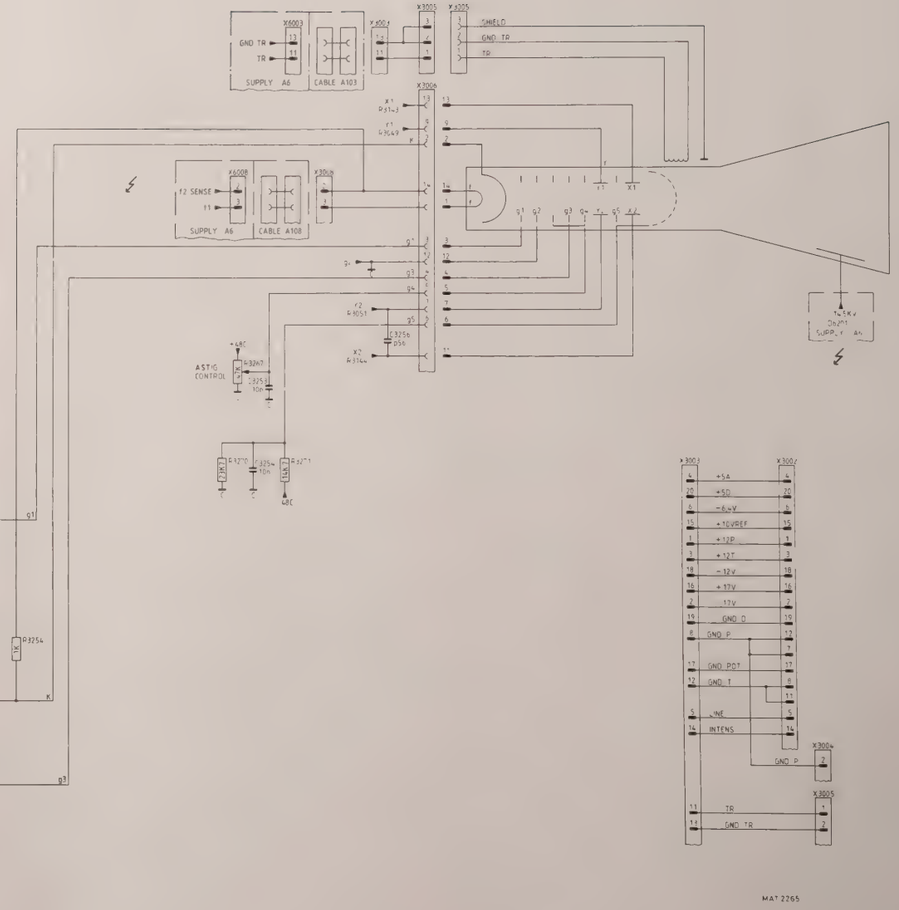


Figure 6.4 Circuit diagram of XYZ amplifier, Z amplifier and CRT circuit

7. TIME–BASE UNIT (A4)

The time-base unit consists of:
- Trigger amplifier
- Timing circuit
- Sweep generators
- X DEFL amplifier, incl. display mode switch
- Horizontal pre-amplifier
- Z amplifier

As a supplement, the timing diagrams for several conditions of the time base are given in Section 7.6.

All control pulses for this unit are generated by the time-base control circuit, via the I^2C bus. Integrated circuits D4001 and D4002 convert this series DATA into the parallel control pulses, provided that DLEN TB1, and DLEN TB2 are HIGH.

7.1 TRIGGER AMPLIFIER

* MTB triggering:
The symmetrical trigger current signals TRIGM+ and TRIGM- are derived from the pre-amplifier unit and converted into the asymmetrical MTB trigger voltage via the shunt feedback amplifier V4003 and V4006. The amplifier of this MTB trigger signal is the summation of the voltage swings across R4002 and R4003, which are proportional to the current swing of TRIGM+ and TRIGM-.

* TV triggering:
When the signal TVMTB goes LOW, the normal trigger path is blocked via V4005 and V4007 and the trigger signal is routed via the TV trigger stage V4009...V4018. Transistor V4009 serves to clip the synchronisation pulse and LINE/FRAME selection is obtained by 4016.

* DTB triggering:
The DTB triggering is almost similar to the MTB triggering. For TV triggering, the trigger signal is obtained from V4012 and, determined by C4024; only TV LINE triggering can serve as a DTB trigger signal for TV pictures.

7.2 TIMING CIRCUIT (see Figure 7.1)

The timing for the entire time-base circuit is obtained by D4103 together with its associated components.

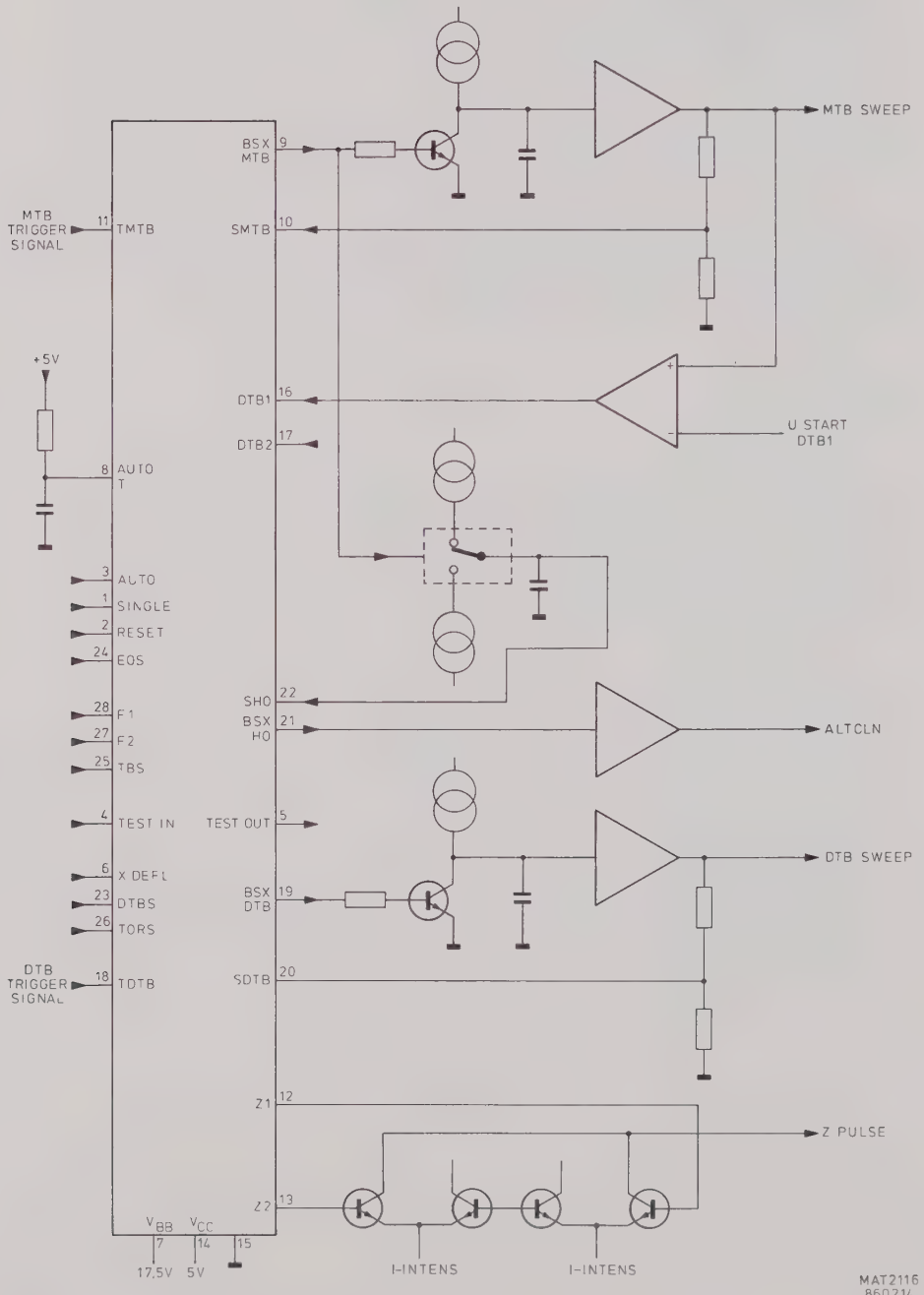


Figure 7.1 D4103 configuration

D4103 has the following relevant pin connections:

Pin	Name	INPUT-OUTPUT	Description
1	SINGLE	TTL-input	Selects the single time-base mode.
2	RESET	TTL-input	Stops the sweep and starts the hold off sweep.
3	AUTO	TTL-input	Selects the AUTO trigger mode, the MTB is free-running after the last trigger pulse.
4	TESTIN	TTL-input	Selects the possibility to drive several functions (TESTOUT) in combination with SINGLE and RESET.
5	TESTOUT	TTL-output	--
6	X DEFL	TTL-input	Activates the Z1 and Z2 outputs.
7	Vbb	-	+1,5 V supply input.
8	AUTOTIME	input	RC-time determination (100 ms) for the AUTO trigger mode.
9	BSXMTB	TTL-output	Discharges the MTB-sweep capacitor(s).
10	SMTB	SCHMITT-input	Determines the end of the MTB-sweep.
11	TMTB	SCHMITT-input	Determines the start of the MTB-sweep.
12	Z2	TTL-output	Determines the blanking of the CRT.
13	Z1	TTL-output	Determines the blanking of the CRT.
14	GND	-	Ground.
15	Vcc	-	+5 V supply input.
16	DTB1	SCHMITT-input	DTB starts, or starts after trigger pulse.
17	DTB2	-	not used, connected to ground.
18	TDTB	SCHMITT-input	Triggers the DTB-sweep when required.
19	BSXDTB	TTL-output	Discharges the DTB sweep capacitor.
20	SDTB	SCHMITT-input	Determines the end of the DTB-sweep.
21	BSXHO	TTL-output	Determines the ALT clock pulse
22	SHO	SCHMITT-input	Determines the end of the Hold-off sweep.
23	DTBS	-	not used; connected to +5 A.
24	EOS	-	Not used; connected to +5 A.
25	TBS	TTL-input	Determines the MTB-unblanking (HIGH) or the DTB-unblanking (LOW).
26	TORS	TTL-input	Determines the STARTS condition (LOW) or TRIG´D condition (HIGH) of the DTB.
27	F1	TTL-input }	Determines the selection for the different horizontal Display modes.
28	F2	TTL-input }	F1 F2 Display mode 0 0 MTB 0 1 MTBI 1 0 DTB 1 1 MTBI and DTB

Note: All SCHMITT-inputs are at +2,5 V level.

7.3 SWEEP GENERATORS

Because the MTB and DTB sweep generators are almost similar, only the MTB sweep generator is described.

* MTB sweep generator (See Figure 7.2):

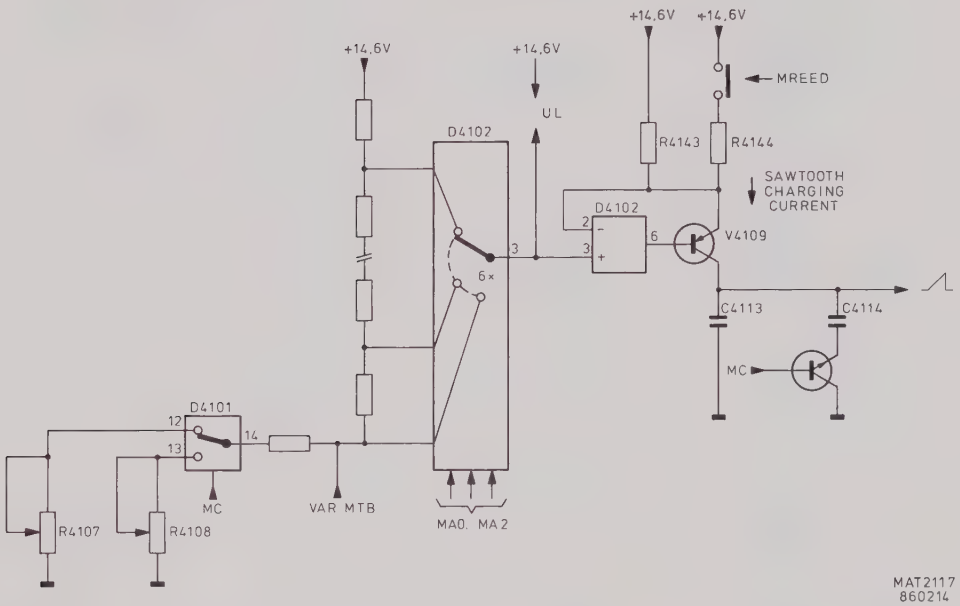


Figure 7.2 Simplified diagram of the MTB

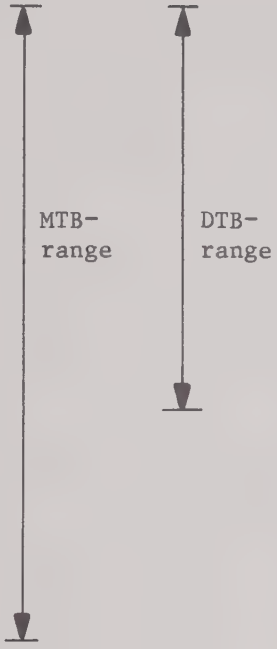
The MTB sawtooth charging current $\frac{U1}{R4143 \text{ (and } R4144)}$ determines the sweep speed via C4113(+C4114).
The circuit is controlled by the following address lines:

- MA0...MA2, for interconnection of D4102-3 to an input pin, thus giving six different voltage levels U1 with respect to +14,6 V.
- MREED, for addition of R4144 to the sawtooth charging circuit.
- MC, for addition of C4114 to the sawtooth charging circuit and for switching over between calibration pot.meters R4107 (50ns...100us) and R4108 (200 us...0,5 s).

The voltage U1 can be continuously varied by moving the VAR MTB control R7009 from the CAL position. Thus a sweep variation of 1:2,5 can be obtained.

The function table for the MTB and DTB sweep generators is given below:

sweep speed	MA2 (DA2)	MA1 (DA1)	MA0 (DA0)	MREED (DREED)	MC (DC)
50 ns	1	1	1	0	0
.1 us	0	1	0	0	0
.2	0	0	1	0	0
.5	0	0	0	0	0
1	0	1	1	0	0
2	1	0	0	1	0
5	1	1	1	1	0
10	0	1	0	1	0
20	0	0	1	1	0
50	0	0	0	1	0
.1 ms	0	1	1	1	0
.2	1	0	0	0	1
.5	1	1	1	0	1
1	0	1	0	0	1
2	0	0	1	0	1
5	0	0	0	0	1
10	0	1	1	0	1
20	1	0	0	1	1
50	1	1	1	1	1
.1 s	0	1	0	1	1
.2	0	0	1	1	1
.5	0	0	0	1	1



Note: when MREED and DREED are low, then RELAY is switched on.

The MTB sawtooth current is fed to the buffer circuit, where the h.f. sweep components (to 2 usec) are routed via C4116 and V4118, V4119.
The l.f. sweep components (0,5 sec...2usec) is routed via N4103.

Finally the MTB sweep and DTB sweep voltages are applied to the horizontal display mode switch.

* Delay time multiplier circuit:
Output signal DTB1 of comparator stage D4402 controls the starting point of the DTB depending on the adjusting of the DTM front-panel control. This signal is applied to D4103-16.
The comparator has two inputs:
- D4402-4 receives the MTB sawtooth voltage.
- D4402-2 receives a fixed adjusted voltage between 0...5 V. Digital-to-analogue (DAC) converter D4401 converts the digital information of the DTM setting (SDA-input) into an analogue current (pin 22), which in its turn is converted into the fixed comparator voltage via N4101.

At the moment that the instantaneous d.c. value of the MTB sawtooth exceeds the voltage on D4402-2, signal DTB1 goes higher.

* Hold-off circuit
During the MTB sweep, capacitor C4304 is discharged. In the lower sweepspeeds (lower then 10us) capacitor C4302 is also discharged via V4306. After the MTB sweep, the capacitor(s) are charged via current source V4304 until the voltage across C4304 reaches the +2,5 V level. This voltage is applied to D4103 as the SHO signal and determines if the MTB can generate a new sweep.

Depending on the HOLD OFF control potentiometer R7011 adjustment, a part of the charging current leaks away via V4301 and thus continuously variation of the charging time (i.e. hold-off time) is obtained. When BSXMTB goes LOW, the MTB starts to run again and at the same time C4304 (and C4302) are discharged again via V4309.

* Alt. clock generator:
At the end of each MTB sweep the signal BSXHO goes low. This signal is routed to V4322 to generate the ALTCLN pulse, which is applied to the pre-amplifier unit A2. The ALTCLN pulse controls the channel switch on that unit at the end of each MTB sweep. When SHO reaches the +2,5 V level, BSXHO goes HIGH again.

7.4 X DEFL AMPLIFIER, AND DISPLAY MODE SWITCH

* X DEFL amplifier
The circuit for converting the symmetrical X DEFL+ and X DEFL- signals into the asymmetrical voltage, applied to the display mode switch is identical to the MTB trigger input. However, this circuit can be switched-off by diodes V4500 and V4505, provided that the X DEFL signal is HIGH.

* Horizontal display mode switch:
The three deflection signals MTB, DTB or X DEFL are switched to the horizontal pre-amplifier via diode switches. These switches are under control of the signals X DEFL and TBS. The output of the circuit is applied to R4701 on the horizontal pre-amplifier stage.
The logic table is given below:

X DEFL	TBS	Output
1	*	X DEFL signal
0	0	DTB sawtooth
0	1	MTB sawtooth

7.5 Z-AMPLIFIER

* Z-switch:
The Z-switch N4601 is configured as two differential amplifiers with a common current output to R4625. The stage is supplied by a constant current source via pin 1 and pin 8. The inputs Z1 and Z2 are derived from the timer stage D4103 and determine the unblanking of the CRT according to Figure 7.3.

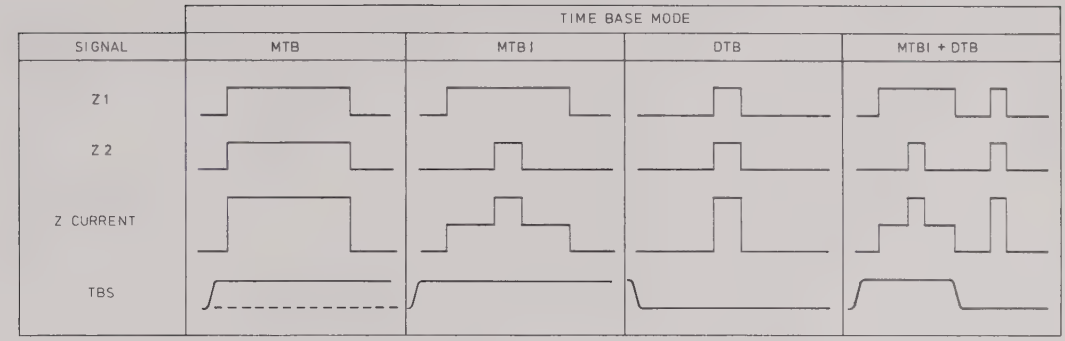


Figure 7.3 Z-logic for the different TB modes.

When both Z1 and Z2 are HIGH, the trace gives normal intensity; when only Z1 or Z2 is HIGH the trace gives half intensity. This means that, in MTBI mode, the DTB part of the trace is more intensified than the MTB part of the trace. The ratio between both intensities is adjusted by R4616. The amplitude of the Z-current can be varied by the front-panel INTENS control R5001. The slider of this control potentiometer drives the base pin 2 and pin 7 of both current sources.

To prevent burn-in of the CRT in the lower sweep speeds 0,5 sec...50 usec, signal ZB is LOW and reduces the voltage to pin 2 and pin 7.

Signal ZA is a software-controlled pulse to blank the trace when the AMPL/DIV switch is used.

* Z Pre-amplifier:
In normal condition, the fully current for CRT blanking derived from N4601 is routed via R4625, V4612 and R2628 to the XYZ Amplifier A3.

However, there are two conditions for additional blanking:
- In the chopped mode of the vertical channels the display is blanked during switching over between channels. This happens by connecting the CHOPBLN pulse to V4611. When this pulse is HIGH, transistor V4611 conducts and a part of the blanking current flows via V4611 e-c to the +5 kV rail.

- if a HIGH level is applied to the external Z MOD input on the rear panel, this signal causes conducting of V4616 so that a part of the blanking current flows via V4616 e-c to the +5 kV rail.

7.6 TIMING DIAGRAMS

The following figures gives the timing diagrams for D4103 for several conditions of the time-base.
The conditions are:
- a free running MTB sweep
- a triggered MTB-sweep with a delayed sweep
- a triggered MTB-and DTB-sweep

* Free running MTB sweep:

SINGLE	0
RESET	0
AUTO	1
TEST IN	0
X DEFL	0
TORS	0
F1	0
F2	0
DTBS	0
EOS	1
TBS	1

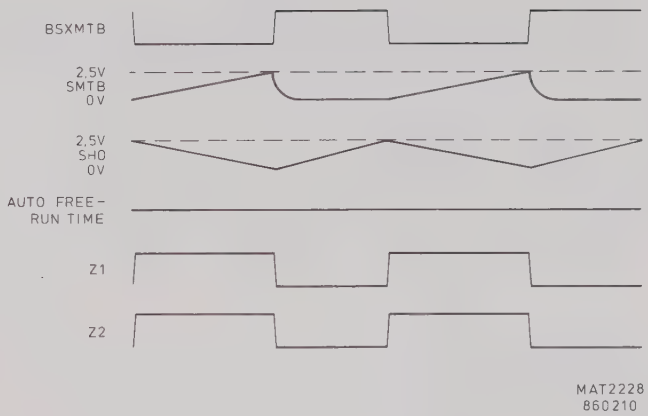


Figure 7.4 Free-running MTB sweep-timing diagram

* Triggered MTB-sweep with a delayed sweep:

SINGLE	0
RESET	0
AUTO	1
TEST IN	0
X DEFL	0
TORS	0
F1	0
F2	1
DTBS	0
EOS	1
TBS	1

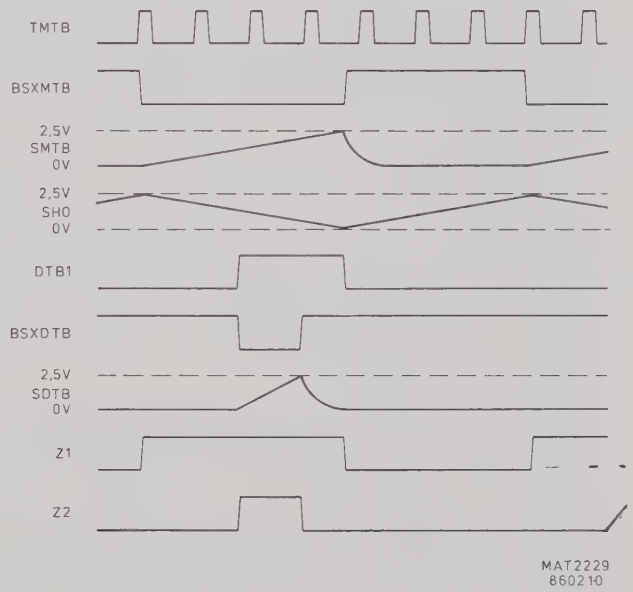


Figure 7.5 Triggered MTB-sweep with a delay sweep-timing diagram

* Triggered MTB- and DTB-sweep:

SINGLE	0
RESET	0
AUTO	1
TEST IN	0
X DEFL	0
TORS	1
F1	1
F2	1
DTBS	0
EOS	1
TBS	*

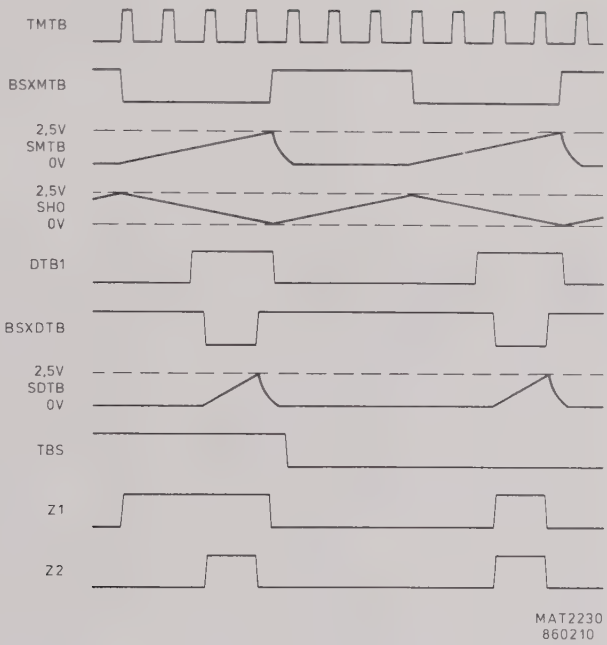
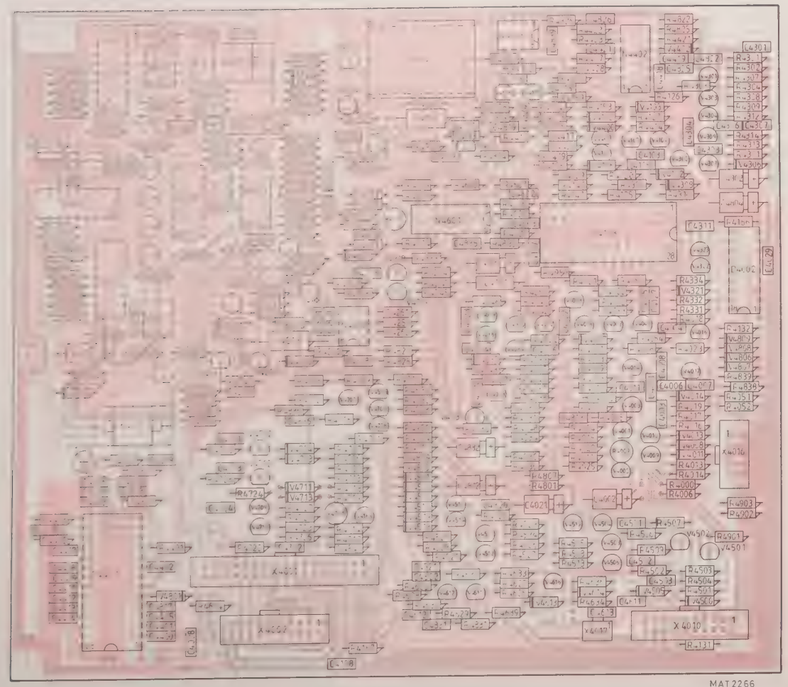


Figure 7.6 Triggered MTB- and DTB-sweep-timing diagram



MAT 2266

Figure 7.7 Time base unit pcb

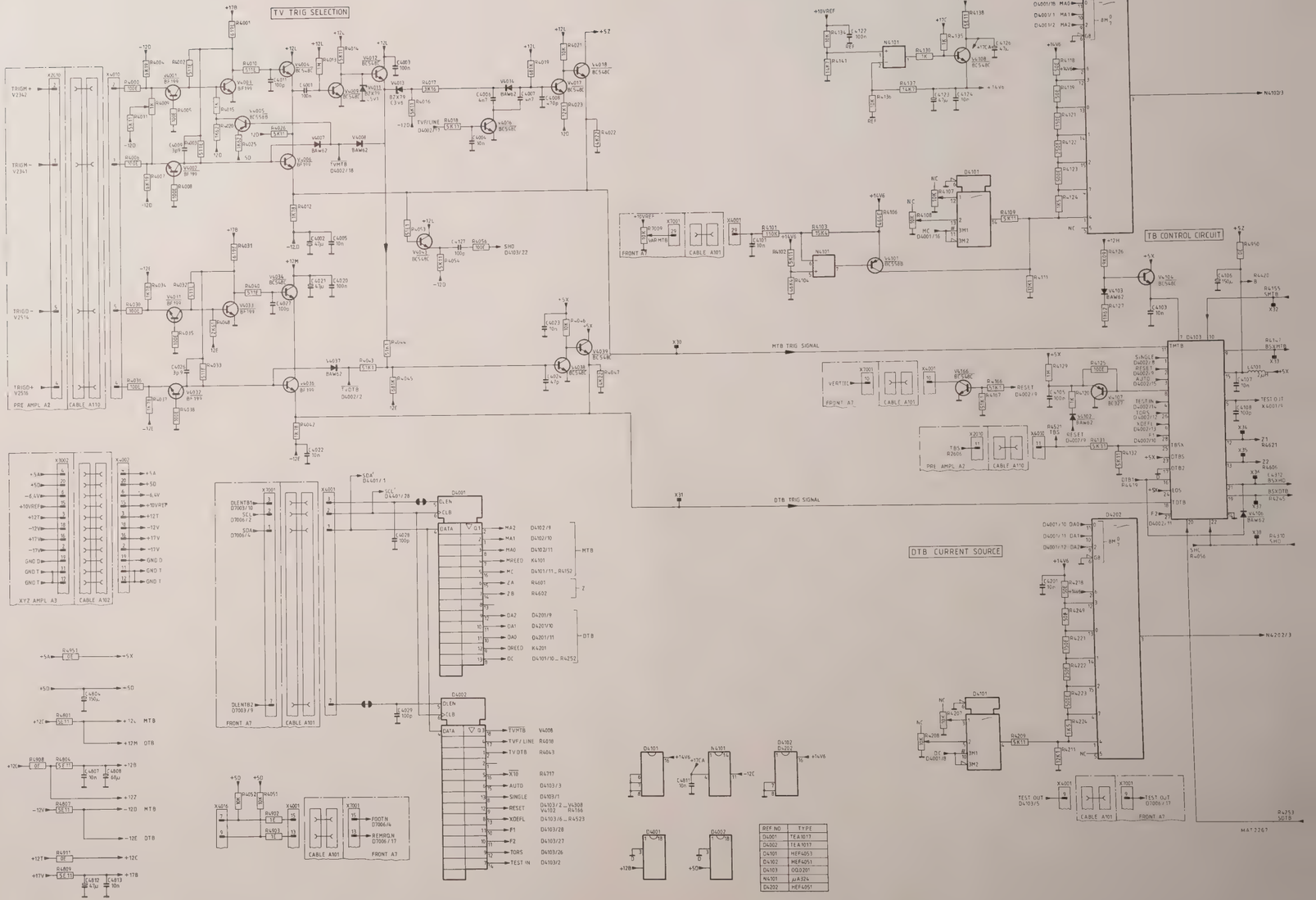


Figure 7.8 Circuit diagram of time-base, trigger amplifier MTB and DTB

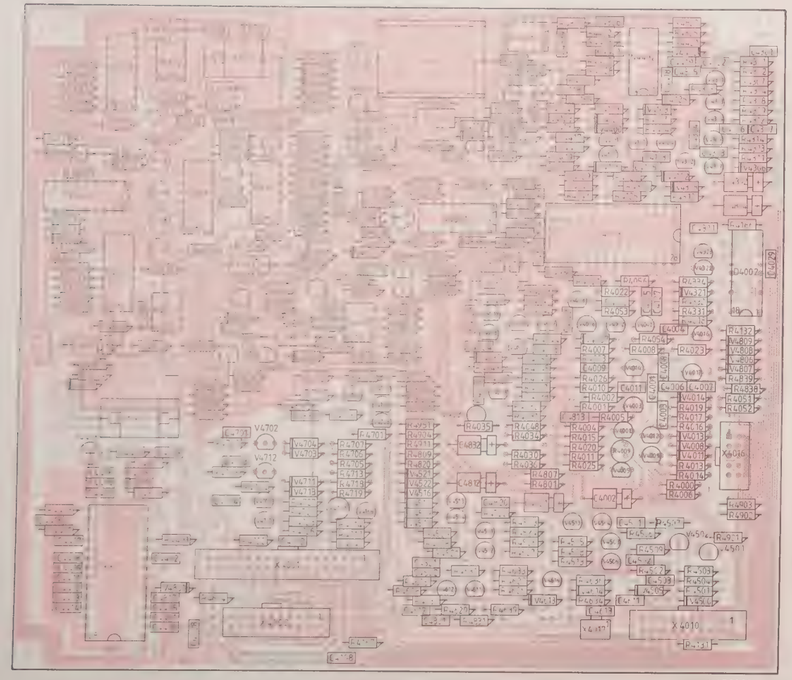


Figure 7.9 Time base unit pcb

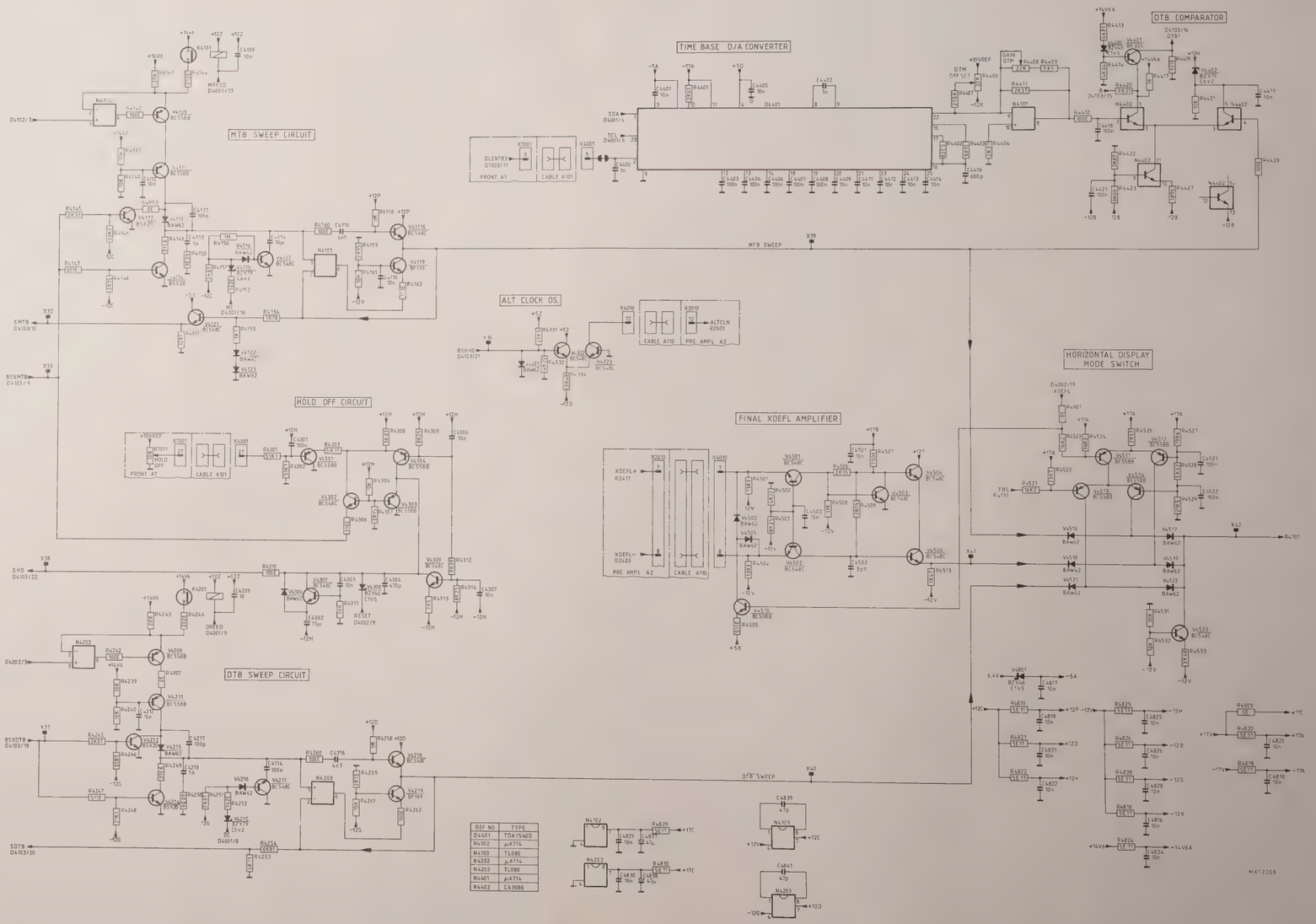


Figure 7.10 Circuit diagram of time base, MTB and DTB sweep circuits and final X DEFL amplifier

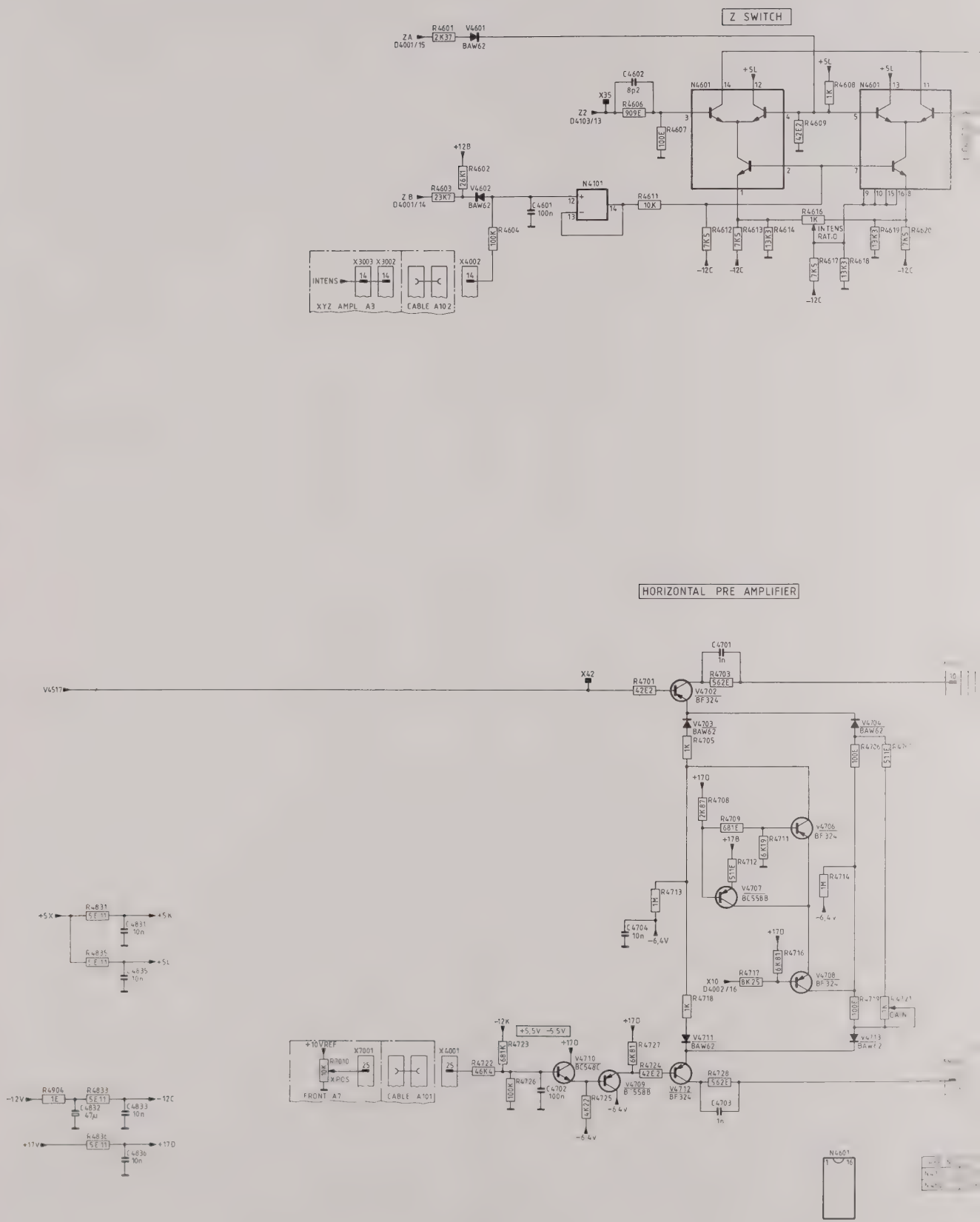
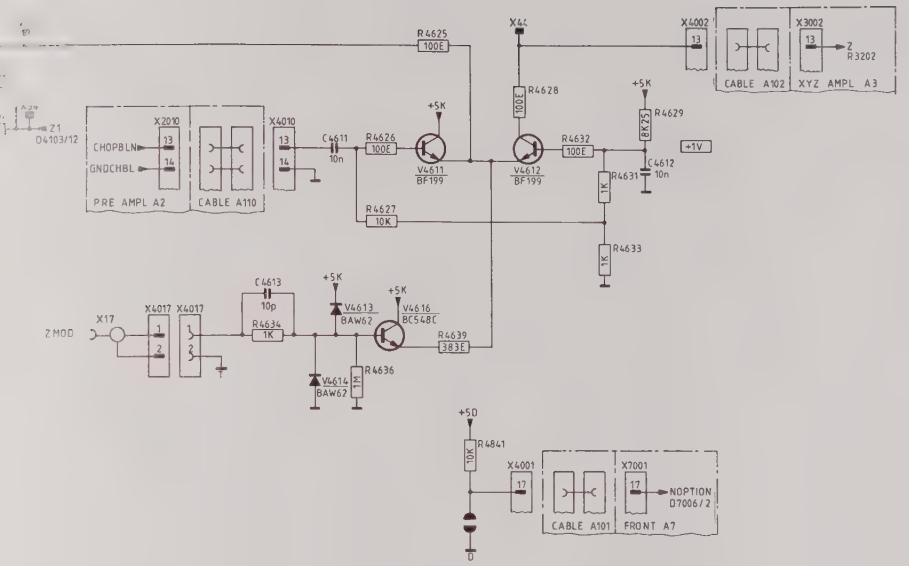
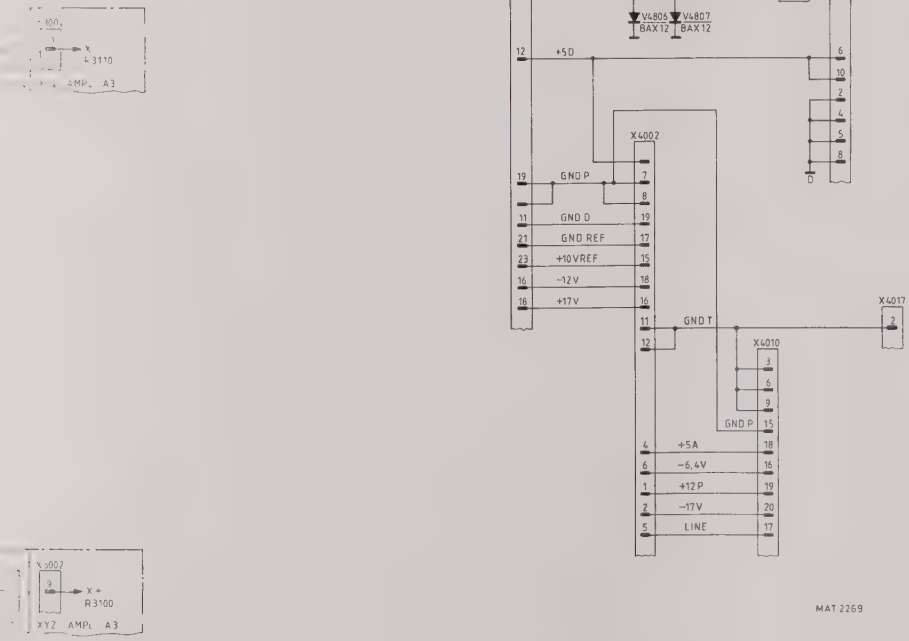


Figure 7.11 Circuit diagram of time-base, X pre-amplifier and Z switch


R4625 100E
X4002
X3002
CABLE A102
XYZ AMPL A3
Z R3202
R4628 100E
+5K
R4629 8K25
+1V
X2010
X4010
CHOPBLN
GNDCHBL
PRE AMPL A2
CABLE A110
C4611 10n
R4626 100E
V4611 BF199
V4612 BF199
R4632 100E
C4612 10n
R4631 1K
R4627 10K
R4633 1K
C4613 10p
R4634 1K
V4613 BAW62
V4616 BC548C
R4639 383E
X17
X4017
ZMOD
V4614 BAW62
R4636 1M
+5D
R4841 10K
X4001
X7001
CABLE A101
FRONT A7
NOPTION D7006/2


+5D
V4808 BAX12
V4809 BAX12
X4001
X4016
SDA
SCL
R4838 100E
R4839 100E
V4806 BAX12
V4807 BAX12
+5D
X4002
GND P
GND D
GND REF
+10VREF
-12V
+17V
GND T
X4017
X4010
GND P
+5A
-6,4V
+12P
-17V
LINE

X4002
X
R3110
XYZ AMPL A3

MAT 2269

8. CRT CONTROL UNIT (A5)

This unit incorporates the potentiometers that control the CRT functions. These potentiometers are INTENS (R1), screwdriver operated control TRACE ROT (R2), FOCUS (R3) and ILLUM (R4).
The range of these potentiometers is between 0 V and +10 V.
The way these potentiometers influences the associated circuit is described together with the description of the relevant circuit part.

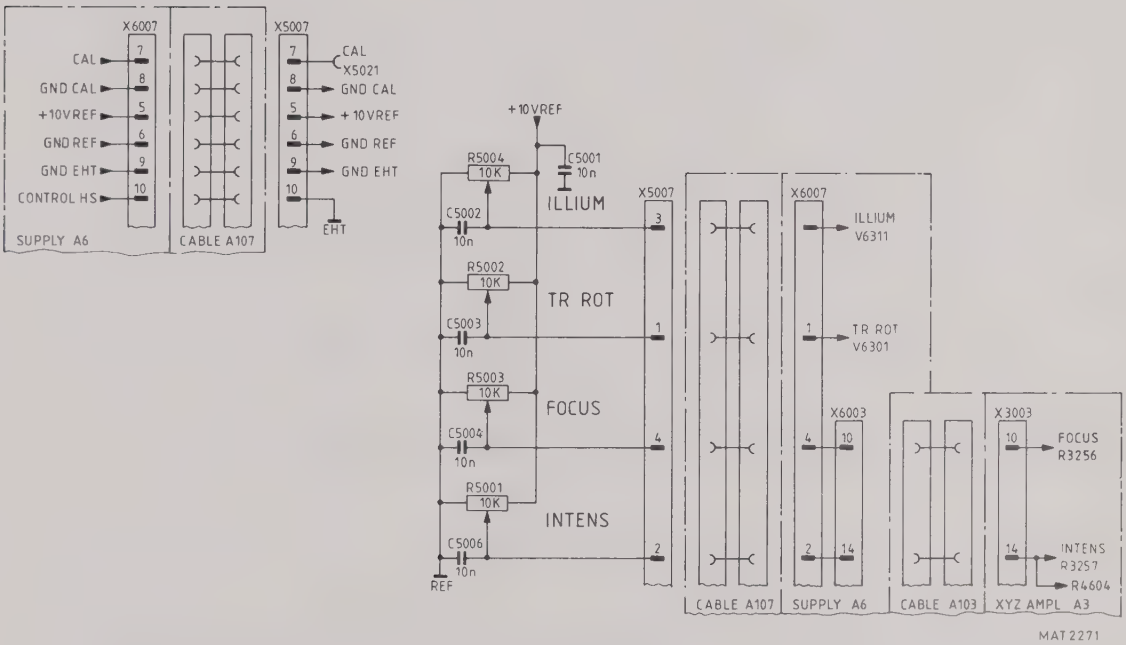


Figure 8.1 Circuit diagram of CRT control

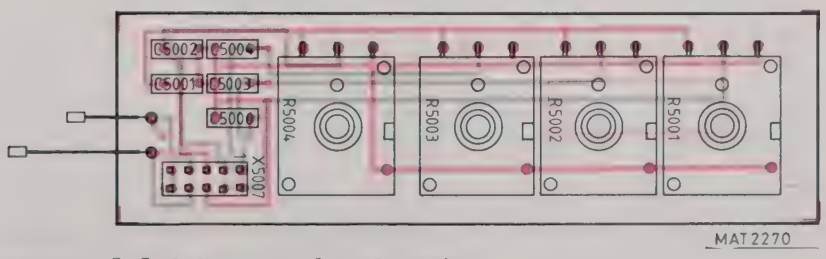


Figure 8.2 CRT control unit pcb

9. POWER SUPPLY UNIT (A6)

Basically, the power supply unit consists of:
- input circuit
- converter circuit
- secondary output rectifiers
- HT supply
- CAL oscillator
- CRT control circuit

9.1 INPUT CIRCUIT

The instrument may be powered from a nominal mains voltage of 90 V...264 V a.c.
The mains voltage is primary protected by a fuse of 1 AT, which is located on the rear of the instrument.

After rectification by the diode bridge V6001...V6004 a d.c. voltage is applied to the converter circuit.
This voltage is smoothed by capacitors C6007, C6008 and choke L6001.
Depending on the mains voltage, the rectified voltage is 120 V...370 V.

A fixed part of the mains voltage serves as a LINE-trigger signal.
The amplitude of the LINE trigger signal is 1/22x MAINS.

NOTE: The LINE trigger signal is <u>not</u> present when a d.c. voltage serves as MAINS.

9.2. CONVERTER CIRCUIT (see Figure 9.1 and Figure 9.2)

The flyback converters consists of transistor V6014 and V6018 and their associated components. The converter frequency depends on the LINE IN amplitude and is for 110 Vac: 30 kHz approx and for 220 Vac: 45 kHz approx.

Transistors V6014 and T6018 conduct on the forward stroke and charge transformer T6001. The thyristor V6013 fires when the voltage on the gate reaches the firing level (0,6 V approx). Consequently, V6018 blocks - V6014 blocks, for the duration of the flyback stroke, during which the secondary windings discharge via the diode rectifiers into the smoothing capacitors. The NTC resistor R6009 provides temperature compensation for the firing point of the thyristor.

During the flyback, capacitor C6009 charges again via the path T6001-1,V6012, V6009, R6004, C6009, L6002 and T6001-2.

The voltage stabilizer with transistor V6009 gives a square-wave to the gate of transistor V6014 with a maximum amplitude of 15 V.

The dv/dt limiter with L6004, L6006, V6017 and V6019 serves to eliminate the switching spikes present on the collector of V6018 (measuring point X46).

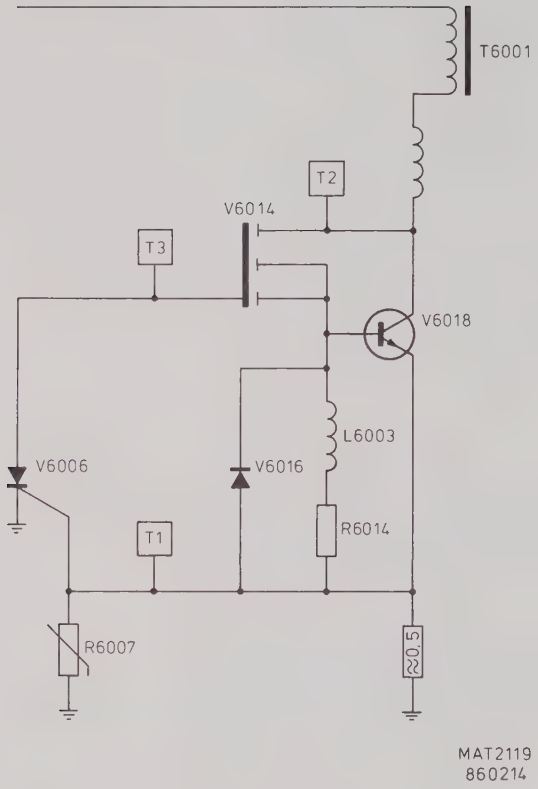


Fig. 9.1 Converter circuit

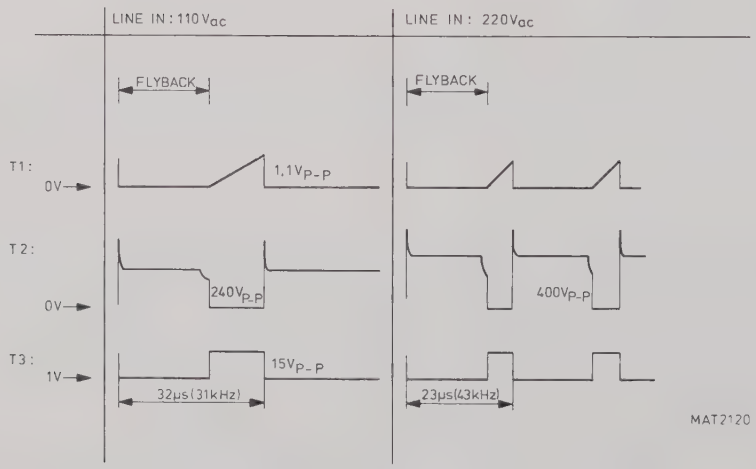


Fig. 9.2 Timing diagram converter circuit

9.3. SECONDARY OUTPUT RECTIFIERS

The output voltages taken from the secondary windings of transformer T6001 are rectified by diodes and smoothed by capacitors in conventional circuits.
A "CROWBAR" circuit with transistor V6137 and V6112 protects the +5 V supply.
When the +5 V level is too high, transistor V6137 (and V6112)conduct and the power supply goes into short circuit mode.

A voltage protection circuit using V6134, V6136 and V6112 protects against overloads protection. When the power supply is overloaded, these components conduct and the power supply goes into in the short-circuit mode.

9.4 HT SUPPLY

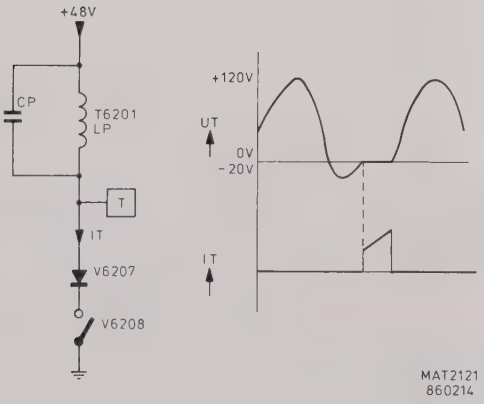


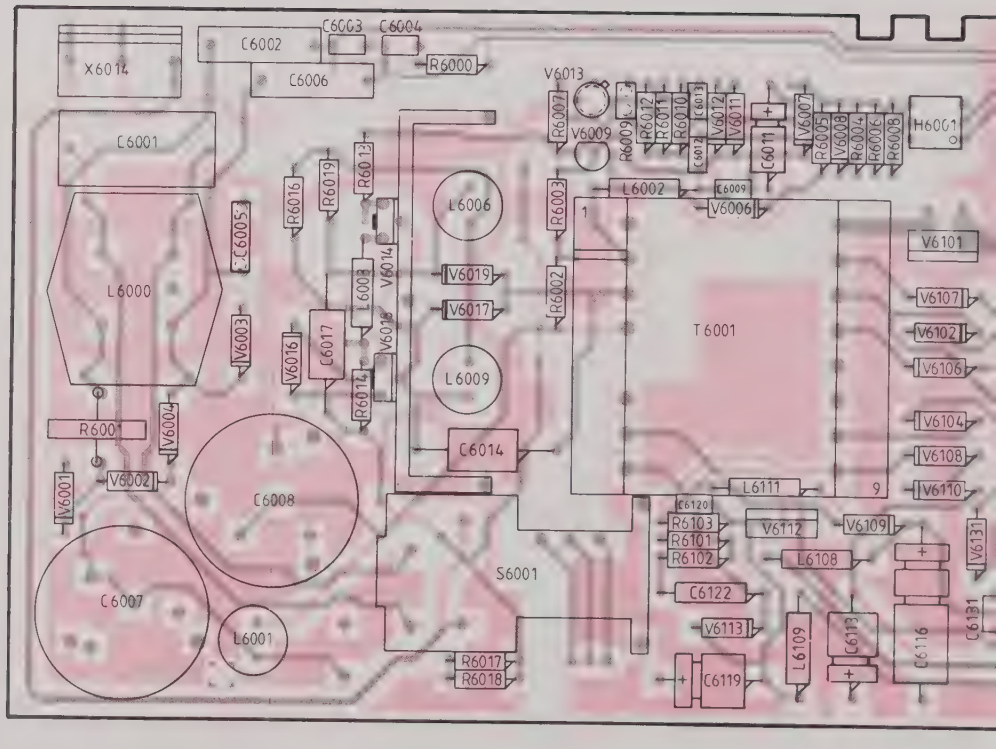
Figure 9.3 HT oscillator

The HT supply consists of an oscillator and a regulator circuit. Transformer T6201 determines the frequency (50 kHz approx.) of the oscillator. The output signal voltage on the secondary winding of T6201 is rectified by diode V6209 and smoothed by C6211. The -2,1 kV is also converted to -14,5 kV in the HT multiplier D6201 and routed viaconnector X6030 to the post-acceleration anode of the CRT.

To regulate this HT voltage the -2 kV is fed to the input of OP-AMP N6002.
The output level of N6002 determines the energy to T6201, and thus the amplitude of the HT-voltage.

9.5 CALIBRATOR

The calibrator circuit consists of two analogue switches D6501(8-9) and D6501(11-12) controlled by the active HIGH enable inputs 6 and 12 respectively, that are connected as an 2 kHz astable oscillator. Capacitor C6502 and resistor R6504 determine the 2 kHz frequency. The oscillator outputs, applied to enable inputs 5 and 13 of the second stage are in anti-phase with each other. Depending on the level of input 5 and 13, the CAL voltage will have a 1,2 V level or a 0 V level.


X6014
C6002
C6003
C6004
C6006
R6000
C6001
V6013
R6007
V6009
R6009
R6012
R6011
R6010
C6013
C6012
V6012
V6011
C6011
V6007
R6005
V6008
R6004
R6006
R6008
H6001
L6002
C6009
V6006
R6003
R6016
R6019
R6013
L6006
V6014
V6019
V6017
L6000
C6005
V6003
C6008
C6017
V6016
V6018
R6014
L6009
T6001
V6101
V6107
V6102
V6106
V6104
V6108
V6110
R6002
R6001
V6004
V6002
V6001
C6014
L6111
9
C6120
R6103
R6101
R6102
V6112
V6109
V6131
L6108
C6008
S6001
C6122
C6007
L6001
V6113
L6109
C6113
C6116
C6131
R6017
R6018
C6119

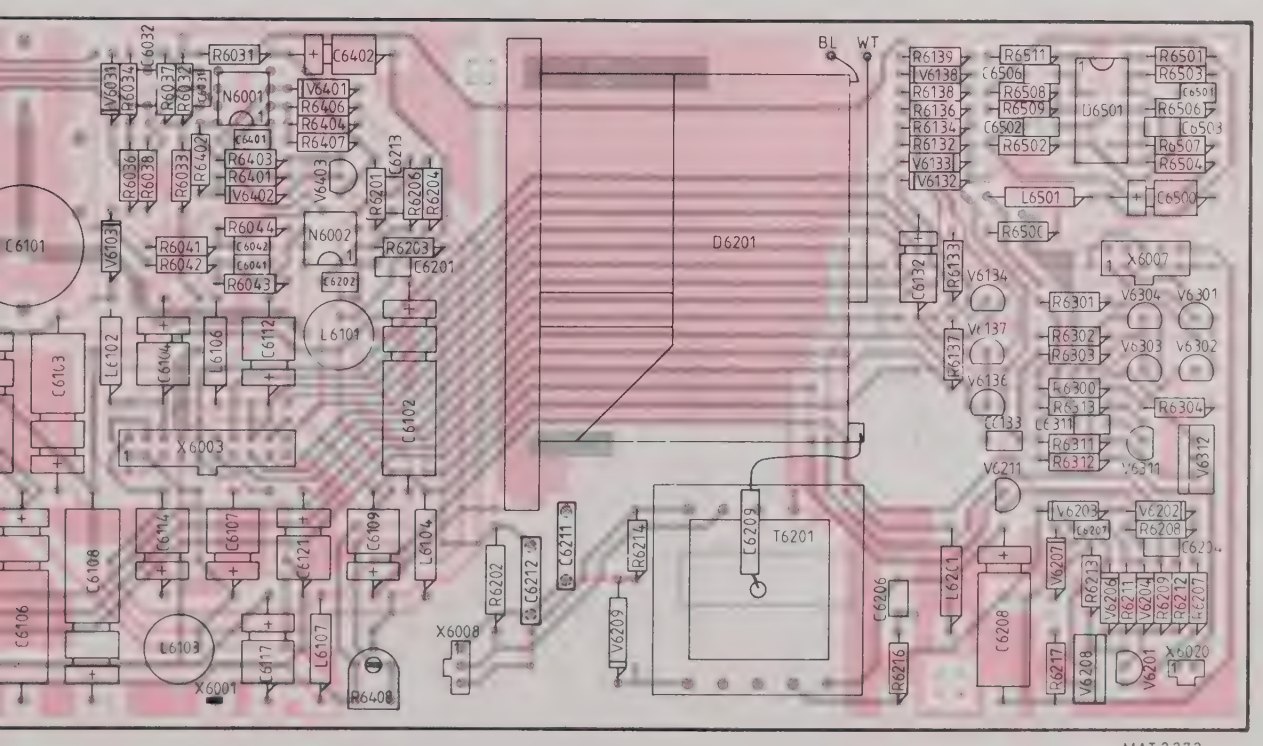
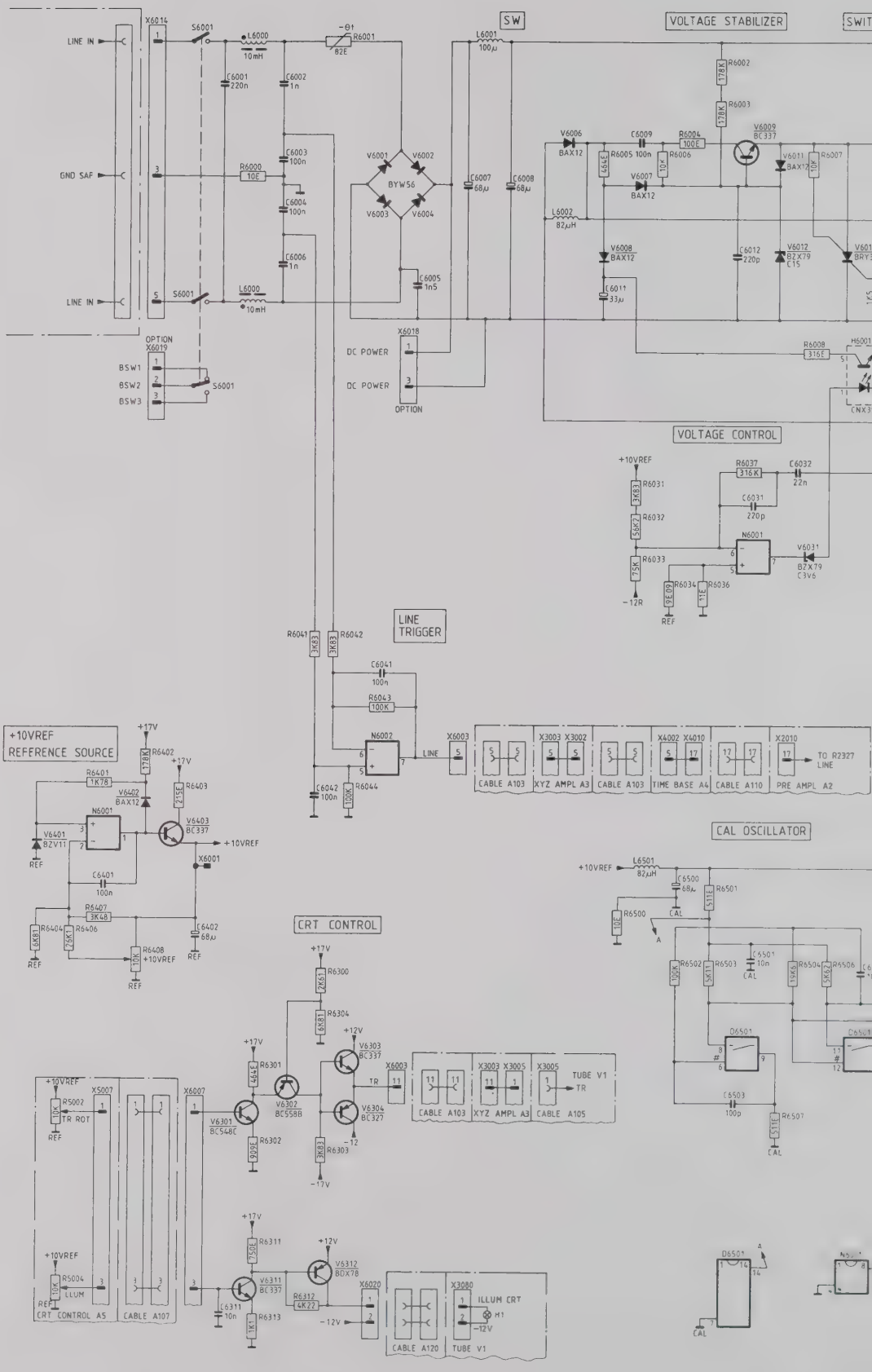


Figure 9.4 Power supply unit pcb


SW
VOLTAGE STABILIZER
LINE IN
GND SAF
LINE IN
X6014
S6001
L6000
10mH
-θ1
R6001
82E
C6001
220n
C6002
1n
C6003
100n
R6000
10E
C6004
100n
C6006
1n
C6005
1n5
V6001
V6002
V6003
V6004
BYW56
L6001
100µ
C6007
68µ
C6008
68µ
R6002
178K
R6003
178K
V6006
BAX12
C6009
100n
R6004
100E
R6005
316E
R6006
10K
V6007
BAX12
V6009
BC337
V6011
BAX12
R6007
10K
L6002
82µH
V6008
BAX12
C6012
220p
V6012
BZX79
C15
C6011
33µ
R6008
316E
OPTION
X6019
BSW1
BSW2
BSW3
S6001
X6018
DC POWER
DC POWER
OPTION
VOLTAGE CONTROL
+10VREF
R6031
3K83
R6032
5K62
R6033
15K
-12R
R6037
316K
C6032
22n
C6031
220p
N6001
V6031
BZX79
C3V6
R6036
31E
REF
LINE
TRIGGER
R6041
3K83
R6042
3K83
C6041
100n
R6043
100K
N6002
C6042
100n
R6044
100K
X6003
LINE
CABLE A103
XYZ AMPL A3
CABLE A103
TIME BASE A4
CABLE A110
PRE AMPL A2
TO R2327
LINE
+10VREF
REFERENCE SOURCE
+17V
R6402
178K
R6401
1K78
V6402
BAX12
R6403
475E
N6001
V6403
BC337
+10VREF
V6401
BZV11
REF
X6001
C6401
100n
R6407
3K48
R6404
6K81
R6405
2K67
R6406
R6408
10K
+10VREF
C6402
68µ
REF
CAL OSCILLATOR
+10VREF
L6501
82µH
C6500
68µ
R6501
511E
R6500
10E
CAL
A
R6502
100K
R6503
5K11
C6501
10n
CAL
R6504
1K65
R6505
5K62
D6501
C6503
100p
R6507
511E
CAL
CRT CONTROL
+17V
R6300
2K61
R6304
6K81
+12V
V6303
BC337
+17V
R6301
4K99
V6302
BC558B
TR
V6304
BC327
-12
V6301
BC548C
R6302
2K09
R6303
3K83
-17V
X6003
CABLE A103
X3003
X3005
XYZ AMPL A3
X3005
CABLE A105
TUBE V1
TR
+10VREF
X5007
R5002
10K
TR ROT
REF
CRT CONTROL A5
CABLE A107
X6007
+17V
R6311
150E
+12V
V6312
BDX78
V6311
BC337
R6312
4K22
-12V
X6020
C6311
10n
R6313
1K5
CABLE A120
X3080
ILLUM CRT
H1
-12V
TUBE V1
+10VREF
R5004
10K
ILLUM
REF

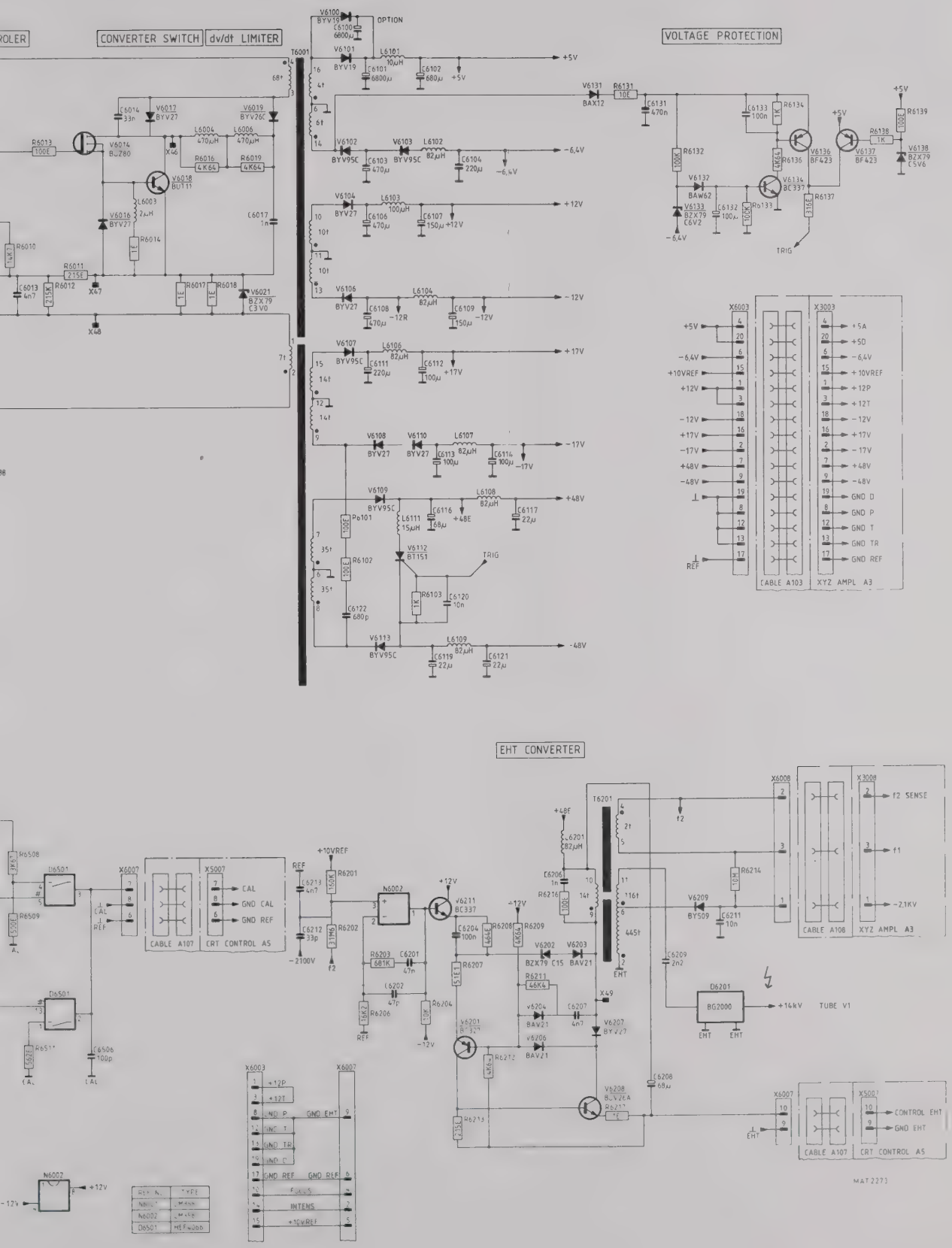


Figure 9.5 Circuit diagram of power supply

10. FRONT UNIT (A7–A8)

The front unit consists of:
- the microcomputer control circuit
- the LCD display circuit
- the front panel controls

10.1 MICROCOMPUTER CONTROL CIRCUIT

10.1.1 Introduction to MAB8052 microcomputer

The integrated circuit MAB8052, one of the MSC-51 family of single chip microcomputers, forms the basis of the microcomputer system of the oscilloscope. The MAB8052 has an internal 8 k ROM and 256 bytes RAM with address/data decoding facilities. In addition to this, the 8052 has 32 I/O lines. Data written to these lines remains unchanged until rewritten. Each line is able to serve as input or output, or both, even though outputs are statically latched. To provide specific serial data transfer possibilities, the microcomputer system contains an I^2C bus interface.

10.1.2 Characteristics of the I^2C bus

The I^2C bus is for 2-way, 3-line communication between different ICs or modules. The three lines are a serial data line (SDA), a serial clock line (SCL) and ground. Both lines must be connected to a positive supply via a pull-up resistor when connected to the output stages of a device. Data transfer may be initiated only when the bus is not busy.

Bit transfer:
One data bit is transferred during each clock pulse. The data on the SDA line must remain stable during the HIGH period of the clock pulse as changes in the data line at this time will be interpreted as control signals.

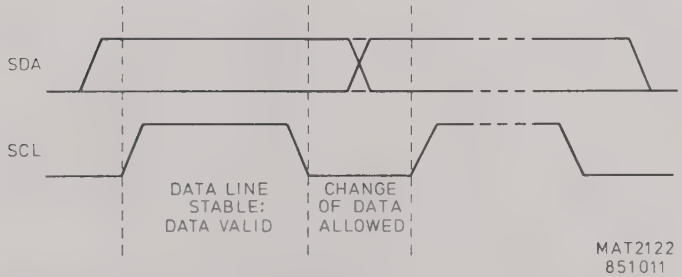


Figure 10.1 Bit transfer

Start and stop conditions:
Both data and clock lines remain HIGH when the bus is not busy. A HIGH-to-LOW transition of the data line, while the clock is HIGH is defined as the start condition (S). A LOW-to-HIGH transition of the data line while the clock is HIGH is defined as the stop condition (P).

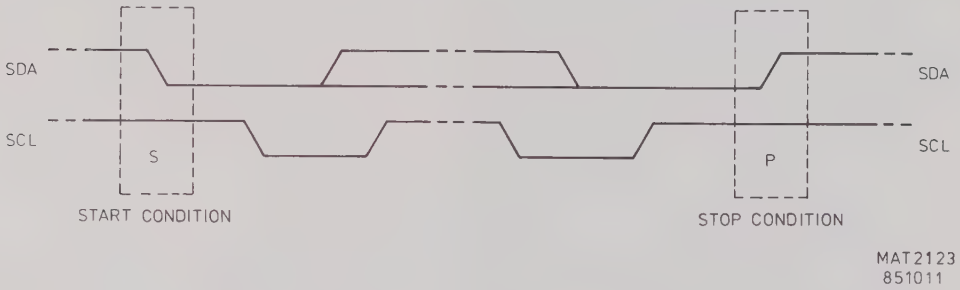
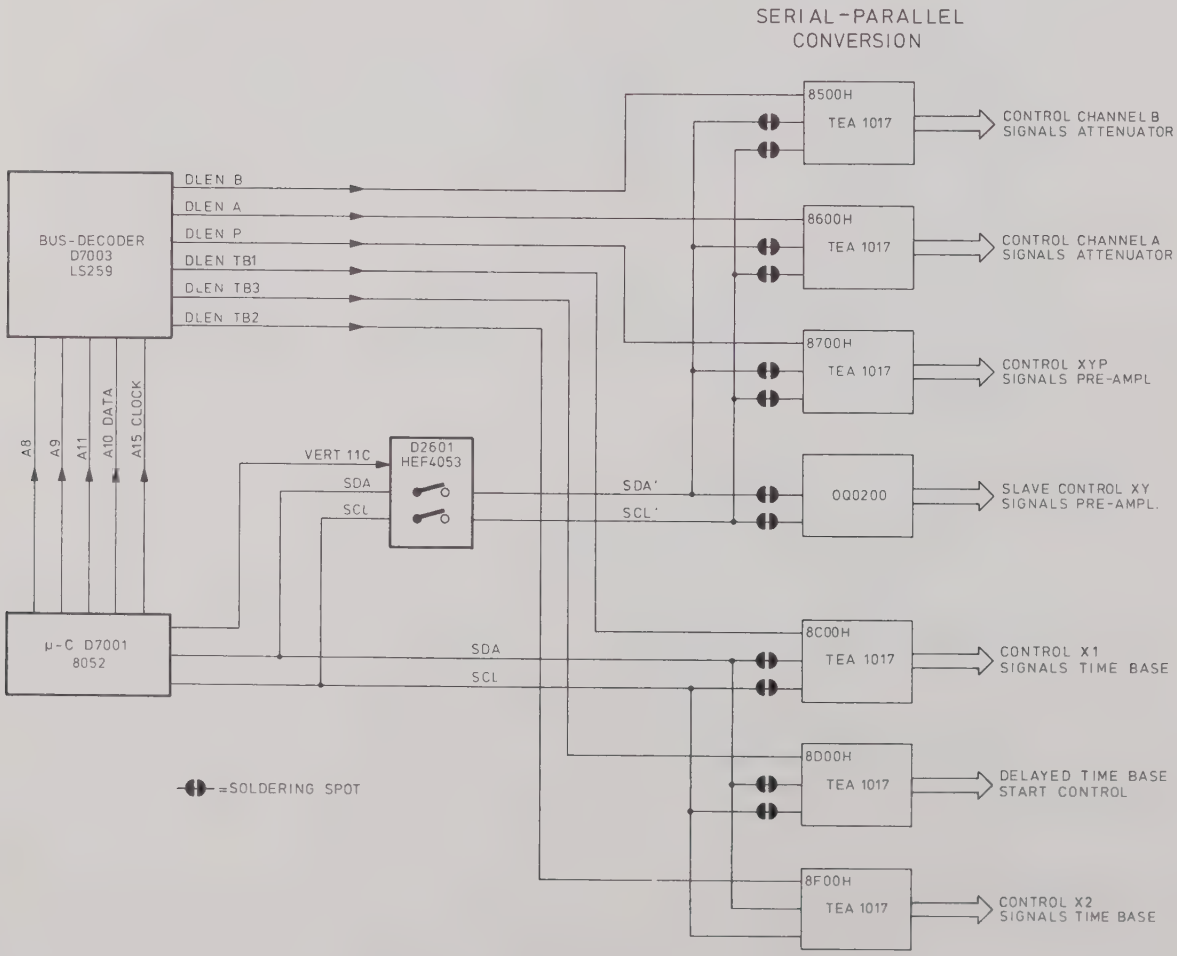


Figure 10.2 Definition of start and stop conditions

10.1.3 I^2C structure

The two lines SDA and SCL are fed to the various circuits, where, depending on the addressing, this serial information is converted into the different control signals (see Figure 10.3).

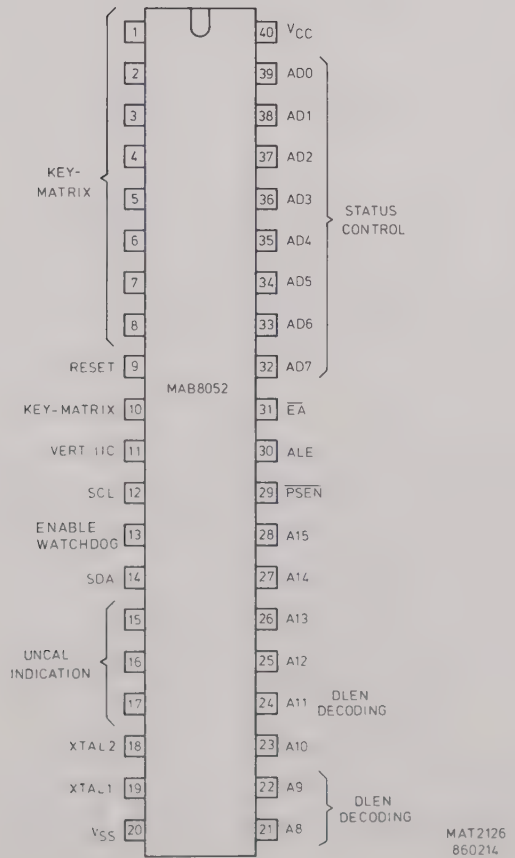


To select the serial-parallel conversion circuits, the bus decoder D7003 decodes the address lines A8, A9 and A11 into the DLEN (Data latch enable) signals according to the next table

ADDRESS LINES A11	A9	A8	DATA A10		
0	0	0	1/0	8400H	SEL IIC
0	0	1	1/0	8500H	DLEN B
0	1	0	1/0	8600H	DLEN A
0	1	1	1/0	8700H	DLEN P
1	0	0	1/0	8C00H	DLEN TB1
1	0	1	1/0	8D00H	DLEN TB3
1	1	0	1/0	8E00H	DLEN TB2
1	1	1	1/0	8F00H	N.C.

To eliminate interference in the vertical circuits, the I^2C bus can be switched off for this circuit by switch D2601. The timing is obtained by the VERT IIC line.
Note that for servicing, solder joints are added in the pcb tracks connecting the circuits. These can be used to localize a fault in the I^2C-bus by means of interrupting the bus connection.

10.1.4. Microcomputer MAB8052



The microprocessor has the following connections:

* Crystal connections (pin 18 and 19)
  A 12 MHz crystal is connected to the inputs XTAL1 and XTAL2 to provide an accurate timing reference source.

* RESET input (pin 9)
  After switching on a reset level HIGH is applied to this input. This reset signal forces the microcomputer to initiate the main program, beginning at the address 00000H. After the +5 V supply is within its specification, the RESET is released and the microcomputer is ready for use.

* 8-bit quasi bidirectional I/O port (pin 1...pin 8) and quasi-bidirectional I/O port (pin 10), used to read the settings of the KEY-MATRIX switches S2...S32 (excl. S12-AUTOSET)

* 3-bit quasi-bidirectional I/O port (pin 15...pin 17), used to read the UNCAL position of S5, S7 and S9 (UNCAL when logic HIGH).

* WATCHDOG input (pin 13)
  The WATCHDOG is a facility to control the correct function of the software. When HIGH the internal counter will run. The software gives a pulse every 64 ms max. to reset this counter, so that the 64 ms max. cycle starts again. If the software does not function correctly, the internal counter receives no reset pulse and the counter will overflow initiating the main program (start address 0000H).

* 8-bit open drain bidirectional I/O port (pin 21...pin 28) used for addressing the serial-parallel conversion circuits (see I^2C structure).

* 8-bit quasi-bidirectional I/O port (pin 32...pin 39) used to read the status input via D7006.

* SDA (pin 14); SCL (pin 12)
  Bidirectional I^2C lines.

* VERT IIC (pin 11)
  Signal used as a digital switch control to switch-off the I^2C bus of the pre-amplifier control.

10.1.5. I^2C decoding

Integrated circuit D7002 serves as a multiplexer to make a separation between the I^2C lines for the LCD drives and the I^2C lines for the other circuits, controlled by the SEL IIC line. Only when SEL IIC is HIGH (address 8400H), are the SDA and SCL lines from the microcomputer connected to unit A8.

10.1.6. Status input

Integrated circuit D7006 serves as an input port to read the following status info:
- TEST OUT, indication for triggered mode, HIGH when triggered.
- FOOTN, remote control for AUTO SET, LOW when active.
- NOPTION, adapts software for optional trigger coupling, LOW when optional triggering.
- REMRQN, remote request line, LOW when active.
- probe indication status, adapts V/DIV reading for probe attenuation.

When the enable inputs (pin 1 and pin 19) become LOW, the status input is read and copied in the accumulator of the microcomputer via the data lines AD0...AD7.

Note that enabling is only possible when D7002-2 is switched-on to D7002-15, i.e. when A15 is HIGH (address 8000H ... FFFFH).

10.1.7 Probe indicator

Integrated circuit D7004 (0Q0044) detects the kind of probe which is connected to the oscilloscope. Depending on the resistance between the probe indication input (pin 3 for channel A and pin 16 for channel B) and ground, the V/DIV reading of the LCD automatically increases according to the next table.

Pin 3 (16)	Pin 6 (17)	Pin 7 (12)	V/DIV attenuation
2k32	0	0	x10
6k98	1	0	x100
7k68	0	1	x1
10k	1	1	x1

10.1.8 C-Bus decoder

This integrated circuit decodes the address lines A8, A9 and A11 into the DLEN signals.
During the power-up all the lines are reset to LOW.

10.2 LCD DISPLAY CIRCUIT

The LCD is driven by three drivers D8001, D8002 and D8003 (PCF8577). The temperature dependent supply voltage VCPCF is 4 V approx. at 25°C. When the temperature increases, this voltage decreases.
The single-pin built-in oscillator on pin 37 of D8001 provides the modulation frequency for the LCD segment driver outputs. Capacitor C7008 and resistor R7038 are connected to this pin to form the oscillator, with a frequency of 150 Hz approx.
Pin 36 and pin 37 are used to determine the LCD drivers address in the I^2C bus.

The outputs pin 1...pin 32 directly drive the LCD.

Outputs BP1 and BP2 (pin 33 and pin 34) drive the COMMON pins of the LCD.

10.3 FRONT-PANEL CONTROLS

The front-panel controls give a voltage between 0 V...10 V to the various circuits.
To determine the UNCAL condition of VAR A, VAR B or VAR MTB, the d.c. voltages of the slider of the potentiometers are applied to comparator N7001. When the voltage level of the control is lower than 0,7 V, the microcomputer reads a logic LOW on its input and adapts the LCD display to indicate the CAL status (e.g. no flashing ">" sign visible).

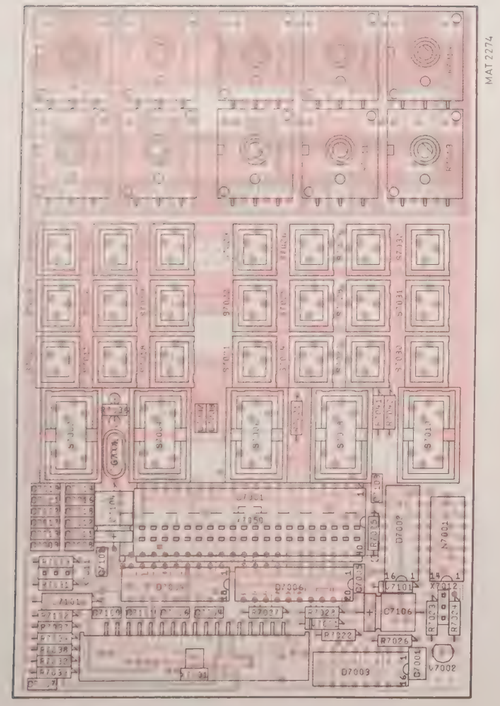
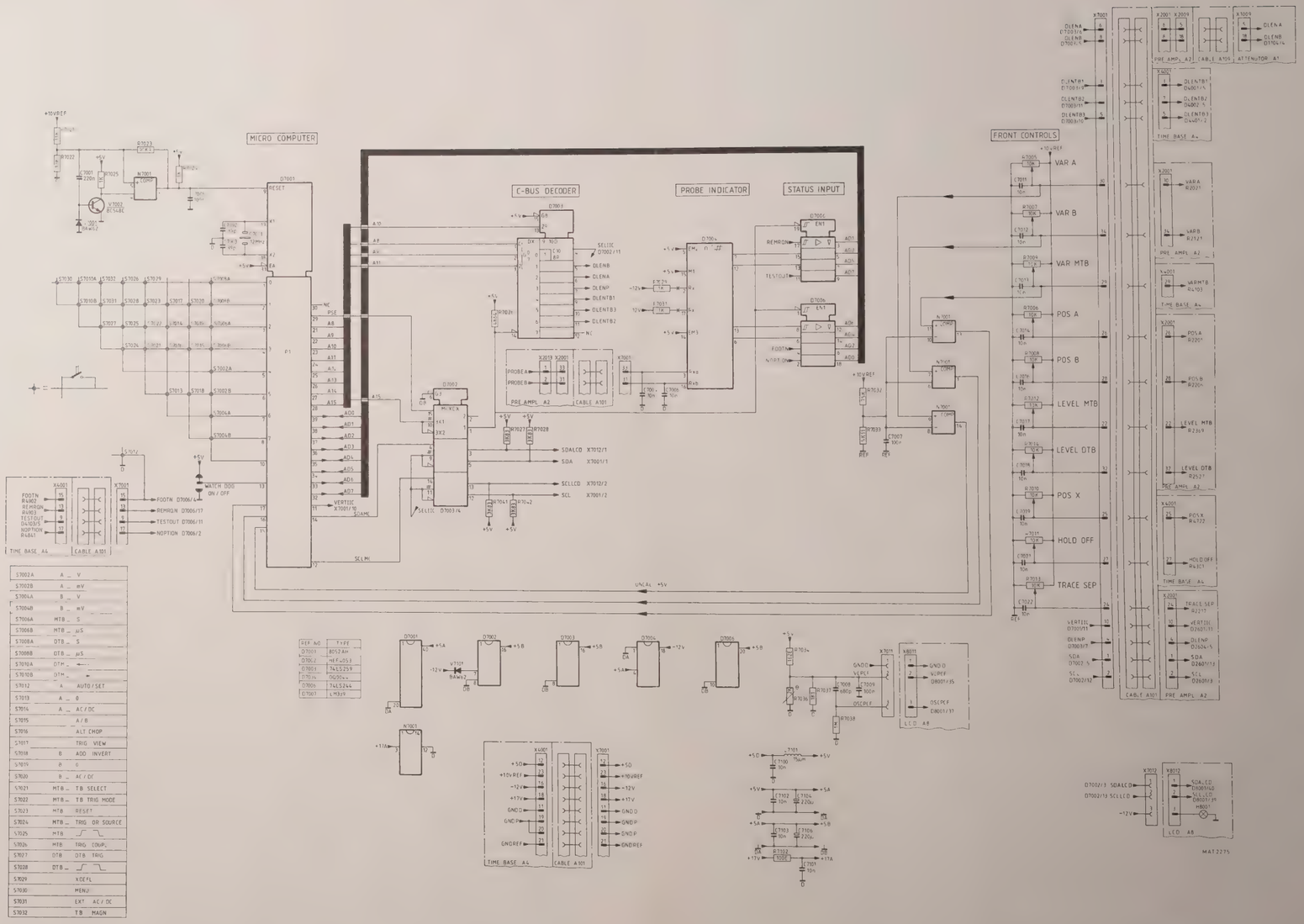


Figure 10.5 Front unit pcb



S7002A	A _ V	
S7002B	A _ mV	
S7001A	B _ V	
S7004B	B _ mV	
S7006A	MTB _ S	
S7006B	MTB _ µS	
S7008A	DTB _ S	
S7008B	DTB _ µS	
S7010A	DTM ←	
S7010B	DTM →	
S7012	A _ AUTO/SET	
S7013	A _ 0	
S7014	A _ AC/DC	
S7015	A/B	
S7016	ALT CHOP	
S7017	TRIG VIEW	
S7018	B ADD INVERT	
S7019	B 0	
S7020	B _ AC/DC	
S7021	MTB _ TB SELECT	
S7022	MTB _ TB TRIG MODE	
S7023	MTB RESET	
S7024	MTB _ TRIG OR SOURCE	
S7025	MTB _ ⎍	
S7026	MTB TRIG COUPL	
S7027	DTB DTB TRIG	
S7028	DTB _ ⎍	
S7029	XOEFL	
S7030	MENU	
S7031	EXT AC/DC	
S7032	TB MAGN	

DEF NO	TYPE
D7001	8052AH
D7002	HEF4053
D7003	74LS259
D7004	OQ354
D7005	74LS244
D7007	LM339

Figure 10.6 Circuit diagram of Front unit

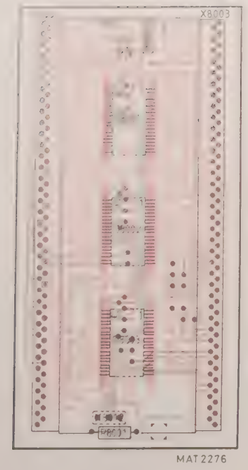
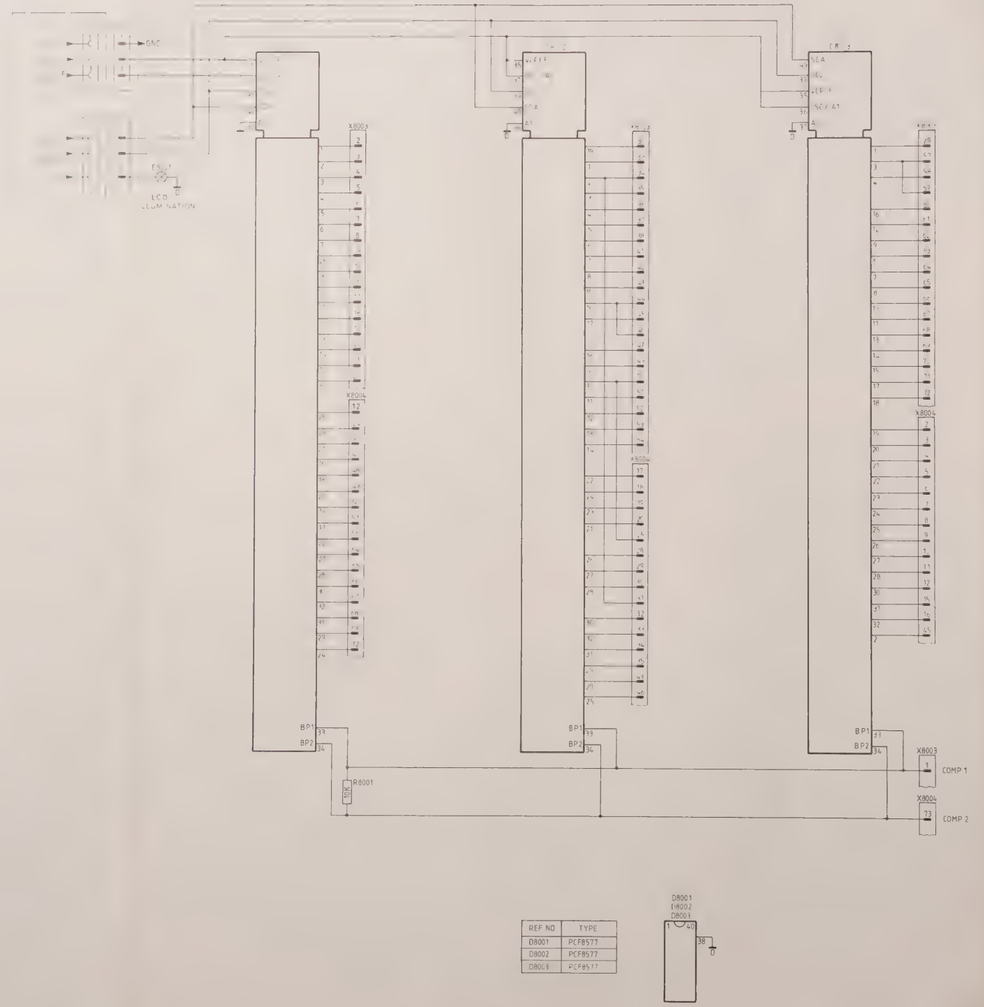


Figure 10.7 LCD unit pcb



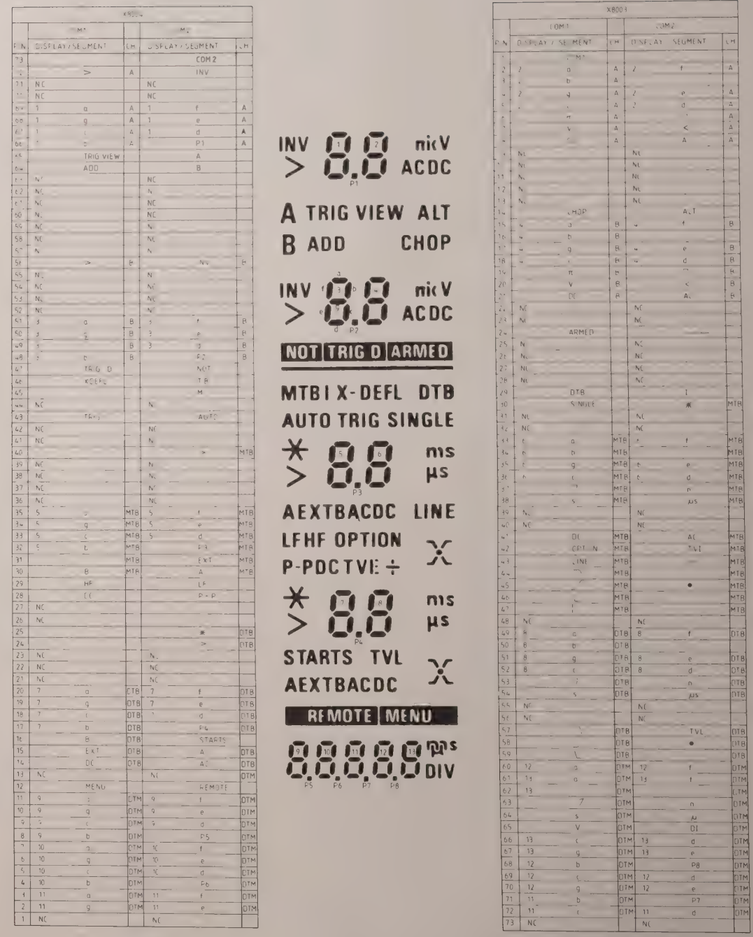


Figure 10.8 Circuit diagram of LCD unit

11. PERFORMANCE CHECK

NOTE: The Chapter PERFORMANCE CHECK is scheduled for the reprint of this service manual. For the time being the instruments can be checked according to the "characteristics" in Chapter 2.

12. DISMANTLING THE INSTRUMENT

12.1 GENERAL INFORMATION

This section provides the dismantling procedures required for the removal of components during repair operations.
All circuit boards removed from the instrument must be adequately protected against damage, and all normal precautions regarding the use of tools must be observed.
During the dismantling a careful note must be made of all disconnected leads so that they can be reconnected to their correct terminals during assembly.

CAUTION: Damage may result if:
- The instrument is switched-on when a circuit board has been removed.
- a circuit board is removed within one minute after switching-off the instrument.

12.2 REMOVING THE TOP AND BOTTOM COVERS

The instrument is protected by two covers: a top cover and a bottom cover. To remove these covers, proceed as follows:
- Slacken the four screws that secure both covers, located at the rear of the instrument.
- Gently push each cover backwards until it can be lifted.
- The covers can be removed by lifting them clear of the instrument.

12.3 ACCESS TO PARTS FOR THE CHECKING AND ADJUSTING PROCEDURES.

After removing both covers (Section 12.2) almost all adjustment and measuring points are accessible. However, for access to the adjusting elements of the time-base unit and the pre-amplifier unit first loosen the upper time-base unit and vertically fix this unit in the available pcb guide fixing.

If necessary, the power supply unit can be lifted out of the instrument.
To do so, proceed as follows:
- Push both parts at the back of the extension shaft towards each other so that the extension shaft can easily be loosened from the ON/OFF switch on the power supply unit.
- Remove the complete extension shaft.
- Push both lips that secure the power supply unit sidewards and gently lift this unit out of the instrument.
- Fix the power supply unit in the available pcb guide fixing.

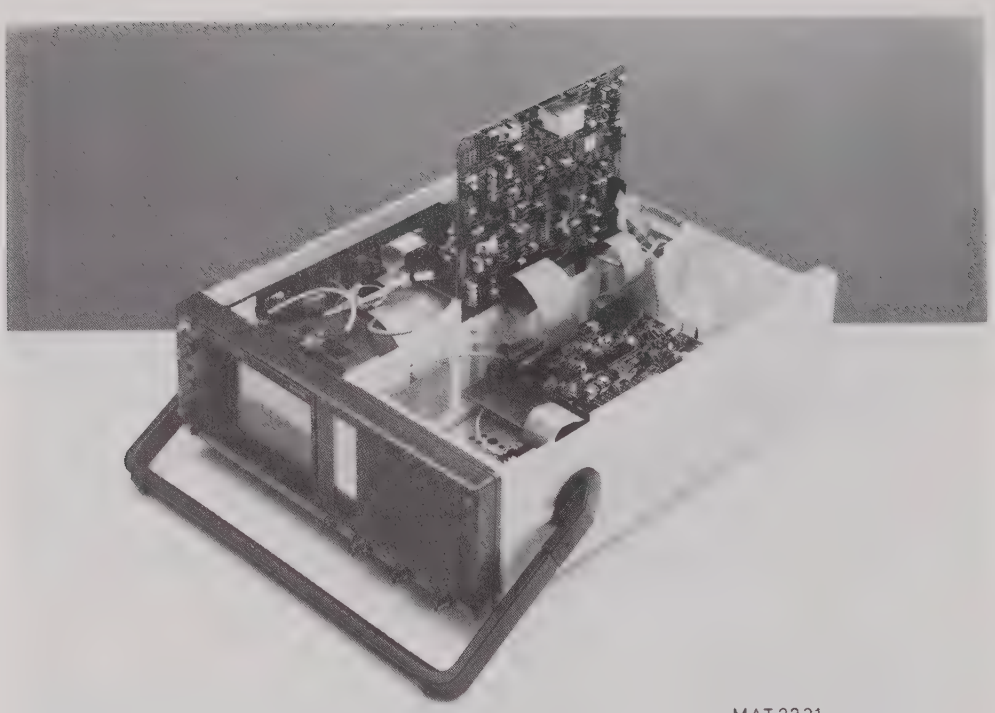


Figure 12.1 Access to all parts for checking and adjusting.

Note: For checking and adjusting the instrument it is <u>not</u> necessary to remove the bottom cover.

13. CHECKING AND ADJUSTING

13.1 GENERAL INFORMATION

The following information provides the complete checking and adjusting procedure for the instrument. As various control functions are interdependent, a certain order of adjustment is necessary.
The procedure is, therefore, presented in a sequence which is best suited to this order, cross-reference being made to any circuit which may affect a particular adjustment.
Before any check or adjustment, the instrument must attain its normal operating temperature.

- Warming-up time under average conditions is 15 minutes.
- Where possible, instrument performance should be checked before any adjustment is made.
- All limits and tolerances given in this section are calibration guides, and should not be interpreted as instrument specifications unless they are also published in Section 2.
- Tolerances given are for the instrument under test and do not include test equipment error.
- The most accurate display adjustments are made with a stable, well-focused low intensity display.
- All controls that are mentioned without item numbers are located on the outside of the instrument.

WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.
The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be opened.
If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by qualified person who is aware of the hazard involved.
Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

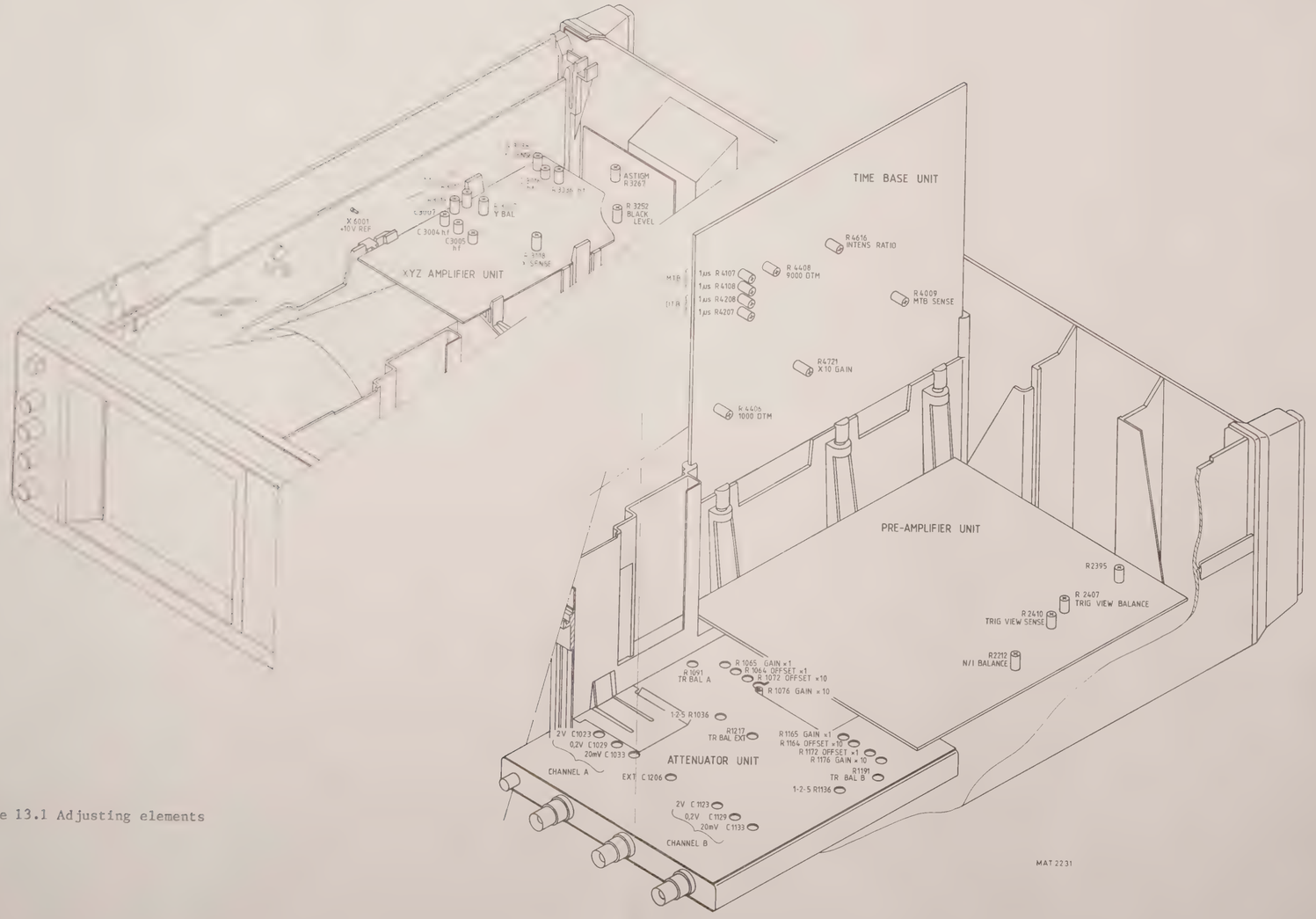


Figure 13.1 Adjusting elements

13.2 RECOMMENDED TEST AND CALIBRATION EQUIPMENT

Type of instrument	Required specification	Example of recommended instrument
Function generator	Freq.: 1 MHz ... 10 MHz Sine-wave/Square-wave Ampl.0...20 Vpp DC offset 0...±5 V Rise-time <30 ns Duty cycle 50 %	Philips PM5134
Constant amplitude sine-wave generator	Freq.: 100 kHz ... 50 MHz Constant ampl. of 120 mVpp and 3 Vpp	Tektronix SG 503
Square-wave calibration generator	For ampl. calibration: Freq.: 1 kHz Ampl.: 10 mV ... 50 V For rise-time measurements: Freq.: 1 MHz Ampl.: 10 mV ... 500 mV Rise-time: ≤1 ns	Tektronix PG 506
Time-marker generator	Repetition rate: 0,5 s ... 0,05 µs	Tektronix TG 501
Digital multimeter	Wide voltage, current and resistance ranges. Required accuracy 0,1 %	Philips PM2524 and high-voltage probe PM9246
Oscilloscope	The bandwidth must be the same or higher than the bandwidth of the instrument under test.	Philips PM3055
Variable mains transformer	Well-insulated output voltage 90...264 Vac	Philips ord.number 2422 529 00005
Moving-iron meter		
Dummy probe 2:1	1 Megohm ±0,1 %//20 pF	
Cables, T-piece, terminations for the generators	General Radio types for fast rise-time square-wave and high freq. sine-wave. BNC-types for other applications	
Trimming tool kit		Philips 800NTX (ord. number 4822 310 50015)

13.3 SURVEY OF ADJUSTING ELEMENTS

ADJUSTING ELEMENT	ADJUSTMENT	INPUT SIGNAL	SECTION
R6406	supply voltage +10 VREF	-	13.4.2
R3252	black level	-	13.4.3
R3267	astigmatism	Sine-wave 120 mV-1 kHz	13.4.3
R4616	intens ratio	-	13.4.3
C1033	1.f.square wave response ch.A at 20 mV	square-wave 120 mV - 1 kHz	13.4.4
C1029	1.f.square wave response ch.A at 0,2 V	square-wave 1,2 V - 1 kHz	13.4.4
C1023	1.f. square wave response ch.A at 2 V	sqare-wave 12 V - 1 kHz	13.4.4
C1133	1.f. square wave response ch.B at 20 mV	square-wave 120 mV - 1 kHz	13.4.4
C1129	1.f. square wave response ch.B at 0,2 V	square-wave 1,2 V - 1 kHz	13.4.4
C1123	1.f. square wave response ch.B at 2 V	square-wave 12 V - 1 kHz	13.4.4
C1206	1.f. square wave response EXT	square-wave 600 mV - 1 kHz	13.4.4
R2410	trig.view sensitivity	square wave 100 mV - 1 kHz	13.4.5
R3038	vertical sensitivity	square-wave 600 mV - 1 kHz	13.4.5
R1069	gain x1 ch.A	square-wave 100 mV - 1 kHz	13.4.5
R1169	gain x1 ch.B	square-wave 100 mV - 1 kHz	13.4.5
R1076	gain x10 ch.A	square-wave 10 mV - 1 kHz	13.4.5
R1176	gain x10 ch.B	square-wave 10 mV - 1 kHz	13.4.5
R3118	horizontal sensitivity	square-wave 100 mV - 1 kHz	13.4.6

ADJUSTING ELEMENT	ADJUSTMENT	INPUT SIGNAL	SECTION
R1036-R1136	offset ch.A (ch.B)	-	13.4.7
R1064-R1164	offset xl ch.A (ch.B)	-	13.4.7
R1072-R1172	offset x10 ch.A (ch.B)	-	13.4.7
R1091	trigger balance ch.A	-	13.4.7
R1191	trigger balance ch.B	-	13.4.7
R1217	trigger balance EXT	-	13.4.7
R2212	norm/invert balance	-	13.4.7
R2407	trig view balance	-	13.4.7
R3007	vertical balance	-	13.4.7
R4009	sensitivity MTB	Sine-wave 80 mV - 10 kHz	13.4.8
R4108	MTB gain 1 ms	time marker 1 ms	13.4.9
R4107	MTB gain 1 us	time marker 1 us	13.4.9
R4207	DTB gain 1 ms	time marker 1 ms	13.4.10
R4208	DTB gain 1 us	time marker 1 us	13.4.10
R4721	gain x10 MAGN	time marker 100 us	13.4.11
R4406-R4408	offset-gain DTM	-	13.4.12
R3017	h.f. square-wave response	square-wave 120 mV - 1 MHz rise-time ≤1 ns	13.4.13
R3013			13.4.13
C3007			13.4.13
C3004			13.4.13
C3005			13.4.13
R3036			13.4.13
C3016			13.4.13

13.4 CHECKING AND ADJUSTING PROCEDURE

The adjusting elements and measuring points are given in figure 13.1.

Note: Use always an insulated adjustment tool.

13.4.1 Preparation

Before starting the checking and adjusting procedure, it is necessary to be aware of the following.
- Unless otherwise indicated, the MAIN TB must be triggered on the channel that is selected for vertical display and the trigger path is P-P coupled. The MAIN TB must function in the AUTO mode and its sweep speed must be adjusted to give good display of the phenomena of interest. The DEL´D TB is not used. The INTENS and FOCUS control must be adjusted to a well-defined trace display.
- Preliminary setting of the controls:
  All VAR controls must be set in CAL position
  All POS and LEVEL controls must be set in mid-position.
  The HOLD OFF control must be set to MIN position.
- Take care to remove the input voltage after each Section.

For better access to the adjusting elements on the time base unit and the power supply unit, proceed as indicated in Section 12.3.

ATTENTION: Do not readjust potentiometer R2395, situated on the Pre-amplifier unit. However, if this potentiometer is inadvertently turned, proceed as follows:
- Set R2395 in its mid-position.
- Readjust R4009 according to Section 13.4.8.

13.4.2 Power supply adjustment

- Connect the instrument to the mains voltage and switch on the oscilloscope.
- Connect a digital multimeter to connection point X6001 (+10V REF) on the power supply unit and the instrument´s ground.
- Adjust R6406 so that the supply voltage is exactly +10 V (tolerance: +or- 0,01 V).

13.4.3 CRT display adjustment

Black level:
- Press X DEFL key
- Set the INTENS control to 10^{o} from its left hand stop.
- Adjust R3252 so that the spot is just not visible.

Trace rotation:
- Press X DEFL key again for deflection via MTB.
- Adjust the front-panel TRACE ROTATION control so that the trace runs exactly in parallel with the horizontal graticule lines.

Astigmatism:
- Apply a 120 mV/1 kHz sine-wave signal to input A.
- Press AUTO SET key.
- Set the INTENS control for normal brightness.
- Adjust R3267 (and the FOCUS control) so that the trace is sharp and well-defined over the whole screen area.

Intens ratio:
- Press TB SELECT key for MTBI.
- Set UP-DOWN MTB to 5 microsec.
- Set UP-DOWN DTB to 1 microsec.
- Set the INTENS control so that the DTB part of the trace is clearly visible.
- Adjust R4616 for a normal visible MTB trace. The DTB part of the

13.4.4 Square-wave response attenuator

Channels A and B:
The vertical adjustments of channels A and B are identical. The indication for channel B are shown in brackets behind those of channel A. It is advisable to perform first the channel A adjustments in this Section.
- Apply a calibrated square-wave signal, frequency 1 kHz to input A (B).
- Press AUTO SET key.
- Press AC/DC key ch.A (ch.B) for DC input coupling.
- Set the adjusting elements for a straight pulse top with a maximum pulse top error of + or - 1,5 % (see table below).

INPUT SIGNAL YA (YB)	UP-DOWN ch.A (ch.B)	Adjusting element
120 mV	20 mV	C1033 (C1133)
1,2 V	0,2 V	C1029 (C1129)
12 V	2 V	C1023 (C1123)

External amplifier:
- Apply a 600 mV/1 kHz calibrated square-wave signal to input EXT.
- Press AUTO SET key.
- Press TRIG VIEW key for TRIG.VIEW.
- Press A/B key for only TRIG VIEW display.
- Press TRIG or X SOURCE key for EXT source.
- Press EXT AC/DC key for DC input coupling.
- Adjust C1206 for a straight pulse top with a maximum pulse top error of + or - 1,5 %.

13.4.5 Adjustment of vertical sensitivities

Trigger view sensitivity:
- Apply a 100 mV/1 kHz calibrated square-wave signal to input A.
- Press AUTO SET key.
- Set UP/DOWN ch.A to 20 mV.
- Press AC/DC key ch.A for DC input coupling
- Press TRIG coupl. key for DC trigger coupling
- Press TRIG VIEW key.
- Adjust R2410 so that both signals are identical.

Sensitivity final Y-amplifier
- Apply a 600 mV/1 kHz calibrated square-wave signal to input EXT.
- Press TRIG VIEW key.
- Press A/B key for only TRIG VIEW display.
- Press TRIG or X SOURCE key for EXT source.
- Press EXT AC/DC key for DC input coupling.
- Press TRIG coupl. key for DC trigger coupling
- Adjust R3038 for a vertical display of exactly 6 divisions.

Note: The vertical position can be adjusted by the MTB LEVEL control.

Gain adjustment channel A (B).
The vertical adjustments of channels A and B are identical. The indications for channel B are shown in brackets after those of channel A. It is advisable to perform first the channel A adjustments in this Section.
- Apply a 100 mV/1 kHz calibrated square-wave signal to input A (B).
- Press AUTO SET key.
- Set UP-DOWN ch.A (ch.B) to 20 mV.
- Press AC/DC key ch.A (ch.B) for DC input coupling.
- Adjust R1065 (R1165) for a vertical display of exactly 5 divisions.

- Apply a 10 mV/1 kHz calibrated square-wave signal to input A (B).
- Press AUTO SET key.
- Set UP-DOWN ch.A (ch.B) to 2 mV.
- Press AC/DC key ch.A (ch.B) for DC input coupling.
- Adjust R1076 (R1176) for a vertical display of exactly 5 divisions.

13.4.6 Adjustment of horizontal sensitivity

- Apply a 100 mV/1 kHz calibrated square-wave signal to input B.
- Press AUTO SET key.
- Press AC/DC key ch. B for DC input coupling.
- Press X DEFL key.
- Press A/B key for channel A selection.
- Set UP-DOWN ch.B to 20 mV.
- Adjust R3118 for a trace width of exactly 5 divisions.

13.4.7 Offset adjustments

The adjustment in this Section are performed in SERVICE MENU "1".
To enter this service menu, proceed as follows:
- Press MENU key.
- Keep MENU key pressed and press also AUTO SET key.
- Check LCD displays: "1", "2" and "3".
- Press V-ch.A (c.i. the left side of the channel A UP-DOWN control).
- Check LCD displays: "1.0".
- Each adjustment procedure can now be sequentially selected by pressing the MENU key. The LCD will indicate which order is selected (1.0...1.8).
- Adjust the potentiometers for minimum trace jump.

MEASURING	ADJUSTMENT	POTENTIOMETER	REMARKS
1.0	1-2-5 adjustment	R1036 (R1136)	
1.1	x1 continue	R1064 (R1164)	rotate VAR A (B)
1.2	x1/x10 offset	R1072 (R1172)	
1.3	trig. balance A	R1091	
1.4	trig. balance B	R1191	
1.5	trig. balance EXT	R1217	
1.6	NORM/INV.	R2212	
1.7	trig.view balance	R2407	
	Y balance	R3007	line in centre of screen.
1.8	DTM 1000-9000	R4406-R4408	see also Section 13.4.13

- Press AUTO SET key twice to leave the service menu again.

13.4.8 Adjustment of trigger sensitivity

- Apply a 80 mV/10 kHz sine-wave signal to input A
- Press AUTO SET key.
- Set UP-DOWN ch.A to 0,2 V.
- Set UP-DOWN MTB to 0,1 msec.
- Ensure that the trace height is exactly 0,4 division.
- Adjust R4009 for a well triggered display.

13.4.9 Adjustment of the MTB sweep times

Adjustment of 1 msec:
- Apply a 1 msec time marker signal to input A.
- Press AUTO SET key
- Set UP-DOWN MTB to 1 msec.
- Adjust R4108 and the X POS control so that the 2nd and 10th marker pulses coincide exactly with the 2nd and 10th vertical graticule lines.

Adjustment of 1 microsec:
- Change the time marker signal to 1 microsec.
- Set UP-DOWN MTB to 1 microsec.
- Adjust R4107 and manipulate the X POS control so that the 2nd and 10th marker pulses coincide exactly with the 2nd and 10th vertical graticule lines.

13.4.10 Adjustment of the DTB sweep times

Adjustment of 1 msec:
- Apply a 1 msec time marker signal to input A.
- Press AUTO SET key.
- Set UP-DOWN MTB to 2 msec.
- Press TB SELECT key for DTB-mode.
- Set UP-DOWN DTB to 1 msec.
- Adjust R4207 and the X POS control so that the 2nd and 10th marker pulses coincide exactly with the 2nd and 10th vertical graticule lines.

Adjustment of 1 microsec:
- Change the time marker signal to 1 microsec.
- Press AUTO SET key.
- Set UP-DOWN MTB to 2 microsec.
- Press TB SELECT key for DTB-mode.
- Set UP-DOWN DTB to 1 microsec.
- Adjust R4208 and the X POS control so that the 2nd and 10th marker pulses coincide exactly with the 2nd and 10th vertical graticule lines.

13.4.11 Adjustment of x10 sweep times

Adjustment of 100 microsec:
- Apply a 100 microsec. time marker signal to input A.
- Press AUTO SET key.
- Set UP-DOWN MTB to 1 msec.
- Press TB MAGN key for x10 magnification.
- Ensure that the LCD gives a 0,1 ms display.
- Adjust R4721 and the X POS control so that the 2nd and 10th marker pulses coincide exactly with the 2nd and 10th vertical graticule lines. This must be valid over 10 % to 90 % of the total X-deflection range.

13.4.12 Adjustment of delay time multiplier

The delay time multiplier adjustment can be performed with SERVICE MENU "1", measuring point 1.8 (see Section 13.4.7)
- Set the start of the trace exactly on the first vertical graticule line by means of the X POS control.
- Enter SERVICE MENU "1".
- Select measuring number "1.8".
- Adjust R4406 and R4408 so that the start of the intensified part of the trace coincides with the 2nd and 10th vertical graticule lines respectively.
- Repeat the adjustments of R4406 and R4408 a couple of times since they are interdependent.
- Depress AUTO SET twice to leave the service menu again.

13.4.13 Square-wave response of final Y-amplifier

Adjustment of square-wave response:
- Apply a 120 mV/1 MHz calibrated square-wave signal with rise time faster than 1 nsec to input A.
- Press AUTO SET key.
- Set UP-DOWN ch.A to 20 mV.
- Set UP-DOWN MTB to 0,5 microsec.
- Adjust the square-wave response with R3017.
- Set UP/DOWN MTB to 0,1 microsec.
- Adjust the square-wave response with R3013 and C3007.
- Press TB MAGN key for x10 magnification.
- Adjust the square-wave response with C3004, C3005, C3016 and R3036.
- Remove the input signal again.

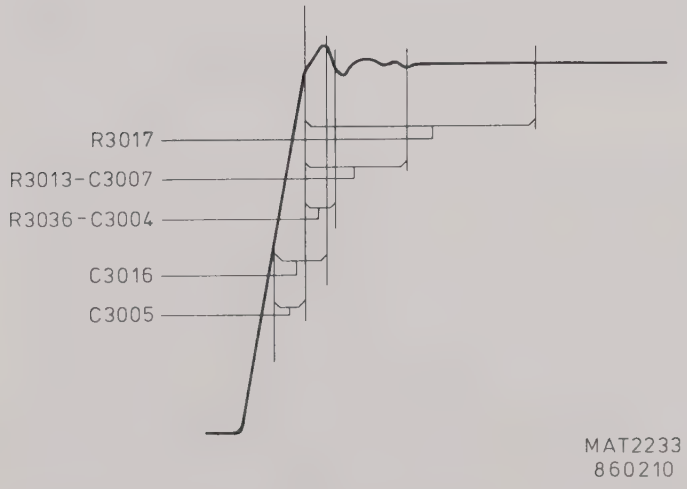


Figure 13.2 Square-wave response.

Checking the chopper interference:
- Press A/B key so that both channels A and B are displayed.
- Press ALT/CHOP key for a chopped display.
- Set UP-DOWN ch.A and ch.B to 1 V.
- Press TB MAGN again for xl magnification.
- Set UP-DOWN MTB to 0,5 msec.
- Press both 0 keys for channel A and B.
- Adjust Y POS A and Y POS B controls for a 6 division distance between both lines.
- Ensure that the chopper interference between both channels is as small as possible; if necessary, readjust R3017.

NOTE: When readjustment of R3017 is necessary, it is recommended to ensure that the h.f. square-wave response is still correct. If necessary, readjust the relevant adjusting components.

Bandwidth check:
The indications for channel B are shown in brackets after those of channel A.
- Apply a 120 mV/50 kHz calibrated sine wave signal to input A(B). This 6 division signal amplitude functions as a reference.
- Press AUTO SET key.
- Set UP-DOWN ch.A (ch.B) to 20 mV.
- Set UP-DOWN MTB to 0,1 msec.
- Ensure that the amplitude display on the screen does not become smaller than 4,2 divisions over the total frequency range up to 50 MHz.

13.4.14 Checking the AUTO SET function
- Set UP-DOWN ch.A to 10 V.
- Set UP-DOWN MTB to 0,5 sec.
- Apply a 120 mV/1 kHz sine-wave to input A.
- Press AUTO SET key.
- Ensure that a triggered sine-wave signal is visible on the screen with 2...5 division amplitude and 2...5 periods.

14. CORRECTIVE MAINTENANCE

14.1 REPLACEMENTS

WARNING :The EHT cable is directly connected to the CRT. When the EHT cable to the post-acceleration anode is disconnected, the cable must be discharged by shorting the terminal to the instrument's earth.

14.1.1 Standard parts

Electrical and mechanical replacement parts can be obtained through your local Philips organisation or representative. However, many of the standard electronic components can be obtained from other local suppliers. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating and description.

NOTE: Physical size and shape of a componenent may affect the instrument's performance, particularly at high frequencies. Always use direct-replacement components, unless it is known that a substitute will not degrade the instrument's performance.

14.1.2 Special parts

In addition to the standard electronic components, some special components are used:
- Components, manufactured or selected by Philips to meet specific performance requirements.
- Components which are important for the safety of the instrument.

ATTENTION: Both type of components may only be replaced by components obtained through your local Philips organisation of representative.

14.1.3 Transistors and Integrated Circuits

- Return transistors and IC's to their original positions, if removed during routine maintenance.
- Do not renew or switch semi-conductor devices unnecessarily, as it may affect the calibration of the instrument.
- Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the socket or pcb-holes and cut the leads to the same length as on the component being renewed.
- When a device has been renewed, check the operation of the part of the instrument that may be affected.
- When re-installing power-supply transistors, use silicon grease to increase the heat-transfer capabilities.

WARNING: Handle silicon grease with care. Avoid contact with the eyes. Wash hands thoroughly after use.

14.1.4 Static-sensitive components

This instrument contains electrical components that are susceptible to damage from static discharge. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.

14.1.5 Handling MOS devices

Though all our MOS integrated circuits incorporate protection against electrostatic discharges, they can nevertheless be damaged by accidental over-voltages. In storing and handling them, the following precautions are recommended.

CAUTION : Testing or handling and mounting calls for special attention regarding personal safety. Personnel handling MOS devices should normally be connected to ground via a resistor.

14.1.5.1 Storage and transport

Store and transport the circuits in their original packing. Alternatively, use may be made of a conductive material or a special IC carrier that either short-circuits all leads or insulates them from external contact.

14.1.5.2 Testing or handling

Work on a conductive surface (e.g. metal table top) when testing the circuits or transfering them from one carrier to another. Electrically connect the person doing the testing or handling to the conductive surface, for example by a metal bracelet and a conductive cord to a chain. Connect all testing and handling equipment to the same surface. Signals should not be applied to the same surface. Signals should not be applied to the inputs while the device power supply is off. All unused input leads should be connected either to the supply voltage or to ground.

14.1.5.3 Mounting

Mount MOS integrated circuits on printed circuit boards after all other components have been mounted. Take care that the circuits themselves, metal parts of the board, mounting tools, and the person doing the mounting are kept at the same electrical (ground) potential. If it is impossible to ground the printed-circuit board, the person mounting the circuits should touch the board before bringing the MOS circuits into contact with it.

14.1.5.4 Soldering

Soldering iron tips, including those of low voltage irons, or soldering baths should also be kept at the same potential as the MOS circuits and the board.

14.1.5.5 Static charges

Dress personnel in clothing of non-electrostatic material (no wool, silk or synthetic fibres). After the MOS circuits have been mounted, the proper handling precautions should still observed. Until the sub-assemblies are inserted into the complete system in which the proper voltages are supplied, the board is not more than an extension of the leads of the devices mounted on the board. To prevent static charges from being transmitted through the board wiring to the device it is recommended that conductive clips or conductive tape is put on the circuit board terminals

14.1.5.6 Transient voltages

To prevent permanent damage due to transfer voltages, do not insert or remove MOS devices, or printed-circuit boards with MOS devices, from test sockets or systems with power on.

14.1.5.7 Voltage surges

Beware of voltage surges due to switching electrical equipment ON or OFF, relays and d.c. lines.

14.2 REMOVING THE UNITS AND MECHANICAL PARTS

Note: For installation, reverse the sequence.

14.2.1 Attenuator unit (A1)

- Push gently both clamping lips that secure the metal locking plate for the attenuator unit and remove the locking plate.
- Push the attenuator unit backwards for about 1 cm.
- Remove the front unit (see Section 14.2.7).
- Remove the control knobs of the CRT control unit.
- Pull gently both clamping lips that secure the front profile gently backwards and loosen the front profile.

Attention: To avoid damage, ensure that the BNCs of the attenuator unit are behind the front profile before loosening the front profile.

Now the attenuator unit can easily pulled out of the instrument after removing the connector with flat cable and the ground connector.

Dismantling the Attenuator unit:
- For access to the components of the unit, remove both upper and bottom covers.

- When removing the BNCs first unsolder the wire to the pcb and then unscrew the BNC-nut with a spanner of max. 5 mm thickness.

14.2.2 Pre-amplifier unit (A2)

- First remove the time-base unit (see Section 14.2.4.).
- Unlock the two pcb supports
- The complete pcb can be removed from the instrument after having removed all flat cables.

14.2.3 XYZ-amplifier unit (A3)

The XYZ amplifier unit incorporates two separate pcbs connected via a flat cable. One pcb includes among other things the CRT socket and must be loosened first. For this, the CRT socket must be gently removed from the CRT.

Now the part situated above the CRT can be removed as follows:
- Remove all flat cables and the delay line cable plug.
- Pull all six clamping lips that secure the XYZ-amplifier unit pcb outwards and take out the complete unit.

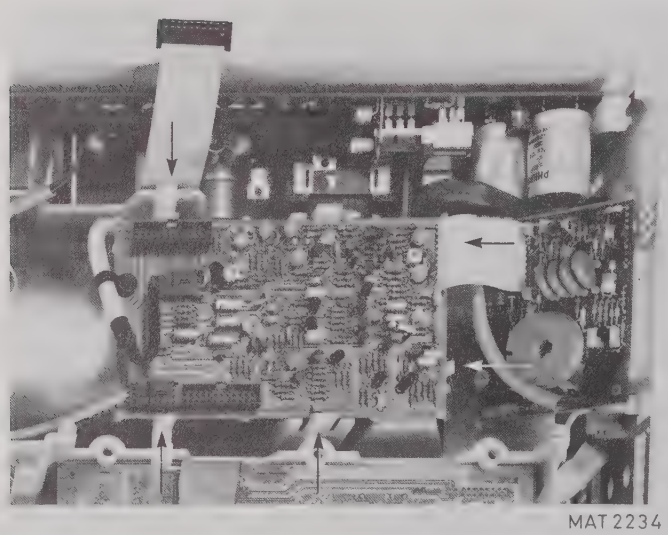


Figure 14.1 Six clamping lips for XYZ-amplifier unit

14.2.4 Time-base unit (A4)

- Unlock the pcb support with a special tool that fits the diameter of the pcb support (see Section 14.6.2).
- The complete pcb can be taken out of the instrument after having removed all flat cables.

14.2.5 CRT control unit (A5)

- Remove the front unit (see Section 14.2.7)
- Loosen the front profile (see Section 14.2.1)
- Now the CRT control unit can be pulled out of the front profile after having removed the flat-cable and the CAL connector.

14.2.6 Power supply unit (A6)

WARNING: Inside the power supply pcb there are many parts that carry dangerous high voltages. Some of these voltages remain some time after disconnecting the instrument from the mains. Therefore, it is recommended to wait at least five minutes after having disconnected the instrument from the mains, before removing the pcb. If working on the power supply unit under live condition cannot be avoided, it must be done by a qualified technician who is aware of the dangers involved.

- Remove the extension shaft from the ON/OFF switch by pushing both ends together.
- Push both clamping lips that secure the power supply unit.
- Lift the power supply unit outside the instrument.
- Place the pbc in the unit slider.

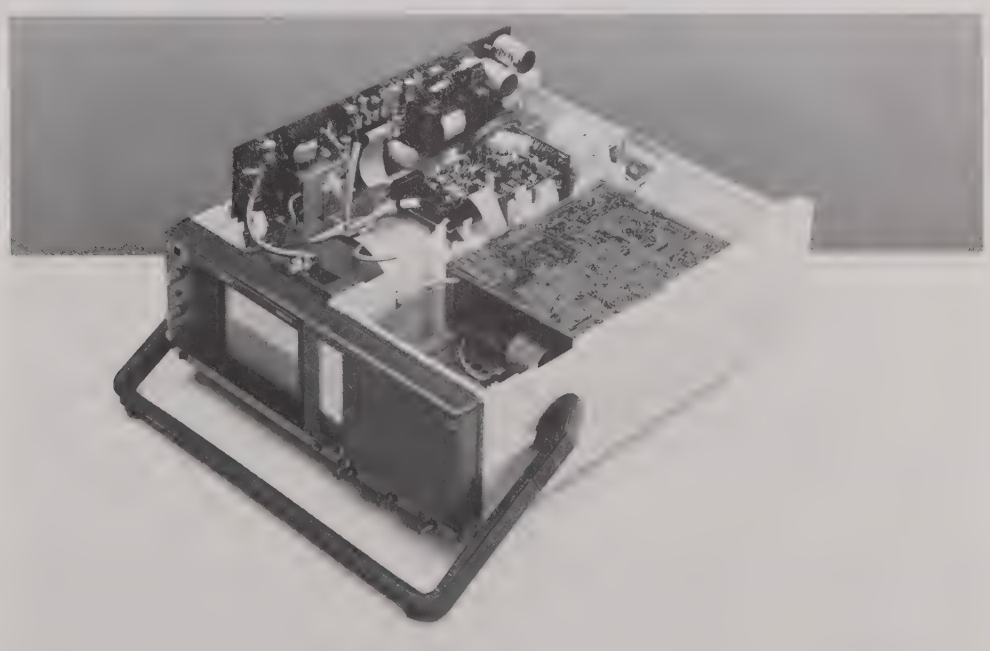
NOTE: After the above actions, the power supply unit can be measured under working conditions, provided that all cables are still connected to the unit.

NOTE: The flat cable to the CRT control unit can easilly be removed now when removing this unit.

- Remove the two flat cables, the power supply cable, the two- and three-pole cable connectors and the EHT-connector from the CRT.

WARNING: The EHT cable is directly connected to the CRT. When the EHT cable to the post-acceleration anode is disconnected, the cable must be discharged by shorting the terminal to the instrument´s earth.

- The power supply can now be taken out of the instrument.



MAT2235

Figure 14.2 Power supply unit outside the instrument

14.2.7 Front unit (A7) and LCD unit (A8)

- Unscrew the two screws, located at the rear of the front unit.
- Now the complete unit assembly can be slid out of the front profile of the instrument.

Note: After the above actions, the front unit can be measured under working conditions, provided that the flat cable is still connected to the unit.

Figure 14.3 Measuring the front unit working condition

For accessibility to the component side of the front unit and LCD unit, proceed as follows:
- Unplug the connector with flat cable
- Remove all control knobs; the knobs can easily pulled off the potentiometer spindles
- Pull all clamping lips that secure the front unit pcb gently outwards and loosen the text plate.

Note: The LCD unit is connected to the front unit by means of two 3-pin connectors and can be easily pulled off.
The LCD display lamp can be reached after pulling off the LCD unit.

14.2.8 Removing the delay line cable

The delay line cable is a 54 cm cable that is connected to the amplifier unit and to the XYZ amplifier unit.
To remove the delay line cable, proceed as follows:
- For access to the delay line cable, remove the time-base unit (see Section 14.2.4) and the pre-amplifier unit (see Section 14.2.2).
- Unlock the plastic clamps that fix the cable to the instrument´s chassis and to the units.
- Remove the plug that connect the delay line cable to the pre-amplifier unit.
- Unscrew the plastic clamp that fix the cable to the XYZ-amplifier unit.
- Remove the plug that connects the delay line cable to the XYZ-amplifier unit.

14.2.9 Replacement of CRT

IMPORTANT: It is strongly recommended to study of this chapter and the associated illustration (Figure 14.4) before starting replacement.

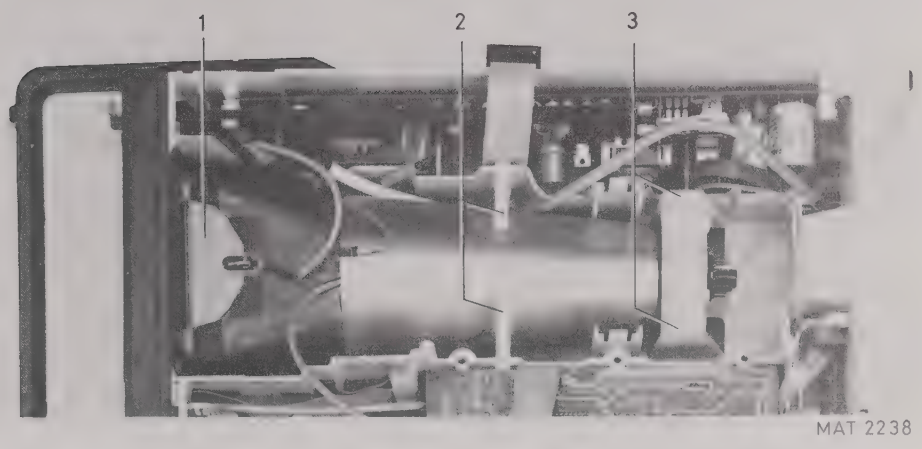


Figure 14.4 Removing the CRT.

- Remove the XYZ-amplifier unit, see Section 14.2.3.
- Remove the graticule lamp holder (1).
- Remove the bezel with the screen filter.
- Remove the two plastic pcb supports (2).
- Unlock the EHT-cable.

WARNING: Handle the CRT carefully. Rough handling or scratching can cause the CRT to implode.

- Push the two clamping lips that secure the CRT support (3) and gently lift the CRT, incl. metal shielding out of the instrument.

NOTE: Before re-assembling a new CRT, first remove its protective cover and place the CRT front rubber around the CRT-front.

14.3 SOLDERING TECHNIQUES

Working method:
- Carefully unsolder one after the other the soldering leads of the semi-conductor.
- Remove all superfluous soldering material. Use a suction iron of suction litze wire.
- Check that the leads of the replacement part are clean and pre-tinned on the soldering place.
- Locate the replacement semi-conductor exactly on its place, and solder each lead to the relevant printed conductor on the circuit board.

NOTE: Bear in mind that the maximum permissible soldering time is 10 seconds during which the temperature of the leads must not exceed 250°C. The use of solder with a low melting point is therefore recommended.
Take care not to damage the plastic encapsulation of the semi-conductor (softening point of the plastic is 150°C).

ATTENTION: When you are soldering inside the instrument, it is essential to use a low-voltage soldering iron, the tip of which must be earthed to the mass of the oscilloscope.

Suitable soldering irons are:
- ORYX micro-miniature soldering instrument, type 6 A, voltage 6 V, in combination with PLATO pin-point tip type 0-569.
- ERSA miniature soldering iron, type minor 040 B, voltage 6 V.
- Low Voltage Mini Soldering Iron, type 800/12 W-6 V, power 12 W, voltage 6 V, order no. 4822 395 10004, in combination with 1mm pin-point tip, order no. 4822 395 10012.

Ordinary 60/40 solder with core and 35 to 40 W pencil type soldering iron can be used for the majority of the soldering. If a higher wattage-rating soldering iron is used on the etched circuit boards, excessive heat can cause the etched circuit wiring to separate from the board base material.

14.4 INSTRUMENT REPACKING

If the instrument is to be shipped to a Service Centre for service or repair, attach a tag showing the full address and the name of the individual at the users firm that can be contacted. The Service Centre needs the complete instrument, its serial number and a fault description. If the original packing is not available, repack the instrument in such a way that no damage occurs during transport.

14.5 TROUBLE SHOOTING

14.5.1 Introduction

The following information is provided to facilitate trouble shooting. Information contained in other sections of the manual should also be used to locate the defect. An understanding of the circuit is helpful in locating troubles, particularly where integrated circuits are used. Refer to the circuit description for this information.

14.5.2 Trouble-shooting techniques

If a fault appears, the following test sequence can be used to find the defective part:

- Check if the settings of the controls of the oscilloscope are correct. Consult the Operating Instructions.
- Check the equipment to which the oscilloscope is connected and the interconnection cables.
- Check if the oscilloscope is well-calibrated. If not, refer to Section 13. "Checking and Adjusting".
- Visually check the part of the oscilloscope in which the fault is suspected. In this way, it is possible to find faults such as bad soldering connections, bad interconnection plugs and wires, damaged components or transistors and IC´s that are not correctly plugged into their sockets.
- Location of the circuit part in which the fault is suspected: the symptom often indicates this part of the circuit. If the power supply is defective the symptom will appear in several circuit parts.

After having carried out the previous steps, individual components in the suspected circuit parts must be examined:

- Transistors and diodes. Check the voltage between base and emitter (0,7 V approx. in conductive state) and the voltage between collector and emitter (0,2 V approx. in saturation) with a voltmeter or an oscilloscope. When removed from the pcb it is possible to test the transistor with an ohmmeter since the base/collector junctions can be regarded as diodes. Like a normal diode, the resistance is very high in one direction and low in the other direction. When measuring take care that the current from the ohmmeter does not damage the component under test.
  Replace the suspected component by a new one if you are sure that the circuit is not in such condition that the new component will be damaged.
- Integrated circuits. In circuit, testing can be done with an oscilloscope or voltmeter. A good knowledge of the circuit part under test is essential. Therefore, first read the circuit descriptions in Sections 3...10.
- Capacitors. Leakage can be traced with an ohmmeter adjusted to its highest resistance range. When testing take care of polarity and maximum allowed voltage. An open capacitor can be checked if the response for AC signals is observed. Also a capacitance meter can used: compare the measured value with the value and tolerance indicated in the parts list.
- Resistors. Can be checked with an ohmmeter after having unsoldered one side of the resistor from the pcb. Compare the measured value with the value and tolerance indicated in the parts list.
- Coils and transformers. An ohmmeter can be used for tracing an open circuit. Shorted or partially shorted windings can be found by checking the waveform responses when HF signals are passed through the circuit. Also an inductance meter can be used.
- Data latches. To measure on inputs and outputs of data latches a measuring oscilloscope can be triggered by the clock signal which is connected to the clock input of the data latch.
  This measurement can only be made in this way when there is an acceptable repetition time of the clock signal. A too low clock pulse repetition time results in a low intensity of the trace on the measuring oscilloscope screen.
  The outputs can easily be checked by a voltmeter or oscilloscope.

14.5.3 Power-up routine

Every time the instrument is switched-on the following initialisation program is executed:
- Resetting the IIC-bus.
- Resetting D2603 (OQ 0200)
- Determinig the SLAVE-address of D2603.
- Checking if Service routine is required (if yes the program will continue with the service routine).
- Checking the "WATCH-DOG" on A7 (if HIGH, all relevant LCD-segments will be lighting for about 1 sec).
- Eventually initialisation of the IEEE-option.

If during the program-run a circuit is found to be faulty, the program stops. It is recommended to switch-off and after a few seconds switch-on again. This will reset the micro-computer controlled system automatically. If the instrument goes in the same faulty situation again, the following procedure indicates how to handle. If no faulure is found, all relevant LCD-segments will be lighting for about one second. After this the normal program is executed.

PROCEDURE:
Check the SDA and SCL lines after haved switched-on. On the SCL a clock-pulse must be present, while the SDA gives the data-information (looks like a random pulse). If one of these signals is not present, you can localize on what unit the fault exists. This can be done by first unplug connector X1009 or X2001 on resp. A1 and A2. To localize what serial-parallel conversion IC is defective, you can disconnect the solder joint in the SDA and SCL print track lead to that IC. The following IC´s can disconnected in this way: D1001, D1101, D2602, D2603, D4001, D4002, D4401.

When the instrument restarts every time again, this means the WATCHDOG is initiating the main program (see also Section 10.1.4), the watchdog can be disabled. This can be done by means of the solder joint jumper on the rear of the front unit pcb (near X7001).
When disabled, pin 13 of the microcomputer is set to a low level.

14.5.4 Trouble-shooting the power supply

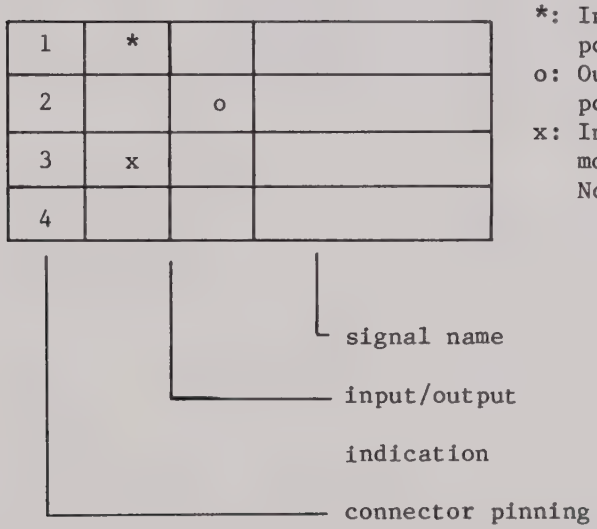
To determine whether a certain fault condition is initiated by the power supply itself or by the connected oscilloscope circuits, a dummy load is listed in the table below. The table gives also an example of the resistor types that can be used to compose the dummy load. These resistors can be ordered at Concern Service.

Supply voltage	Output current	Dummy resistance and their service ordering numbers
+ 5 V	1,2 A	4,18E-6W: 2 x 8,2E (4822 112 21052) in parallel.
- 6,4 V	380 mA	16,8E-2,5W: 18E (4822 12 21061) and 270E (4822 110 53092) in parallel.
+ 12 V	490 mA	25,8E-5,8W: 33E (4822 112 41067) and 120E (4822 112 21101) in parallel.
- 12 V	350 mA	35,4E-4,2W: 47E (4822 112 21072) and 150E (4822 110 23085) in parallel.

+ 17 V	290 mA	60E-5W: 100E (4822 112 21081) and 150E (4822 112 21085) in parallel.
- 17 V	100 mA	171E-1,7W: 270E (4822 110 43098) and 470E (4822 110 43098) in parallel.
+ 48 V	70 mA	687E-3,5W: 820E (4822 112 21105) and 4k7 (4822 110 53125) in parallel.
- 48 V	40 mA	1k22-2W: 2k2 (4822 110 23169) and 2k7 (4822 110 23172) in parallel.

14.5.5 Pcb interconnections

Figure 14.5 gives a survey of all interconnections between the pbc´s and to the CRT. Also the interconnections between the connectors on board level is given in this diagram.
An explanation of the connector indication is given below:

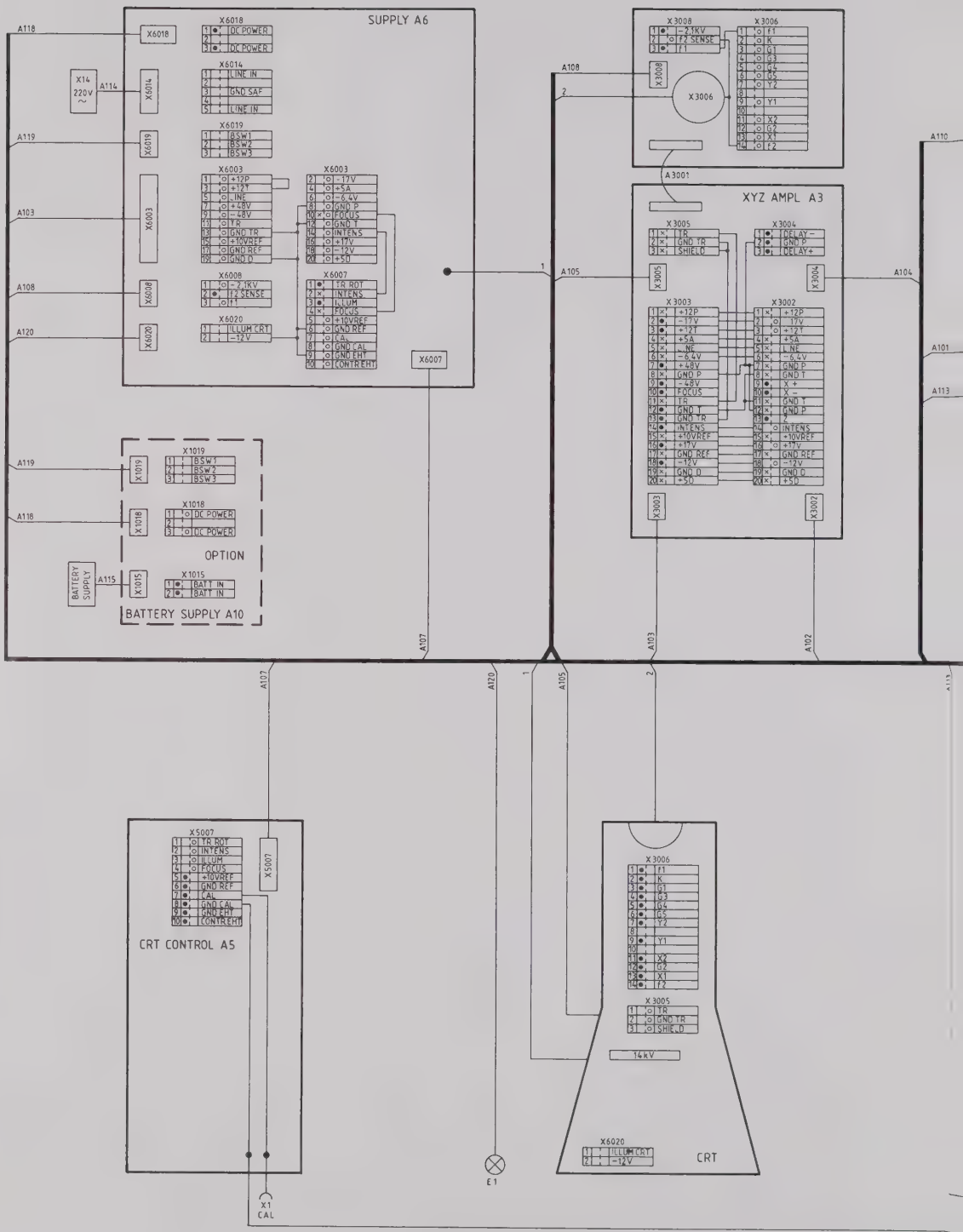


*: Input signal for the related pcb.
o: Output signal for the related pcb.
x: Interconnection between two or more sockets of the pcb. Not used on the related pcb.

14.6 SPECIAL TOOLS

14.6.1 Trimming Kit SBC 317 4822 310 50095

The SBC 317 Trimming Kit matches every current trimming requirement for all products. The set contains 27 items (22 different bits, plus 3 bit holders and 2 extension pieces). The insulated holders and extension pieces make it easy to reach into a chassis and make accurate adjustments, without wasting time or risking shocks.
The SBC 317 Trimming Kit is packed in a flat transparent case. Several of the most commonly required bits are duplicated. In addition, a spare set of 8 bits is separately available as replacement (4822 310 50016)


SUPPLY A6
XYZ AMPL A3
OPTION
BATTERY SUPPLY A10
CRT CONTROL A5
CRT
14kV
X6018
X6014
X6019
X6003
X6008
X6020
X6007
X3008
X3006
X3005
X3004
X3003
X3002
X1019
X1018
X1015
X5007
X1 CAL
E1
A118
A114
A119
A103
A108
A120
A105
A104
A101
A113
A107
A102
A115
A110

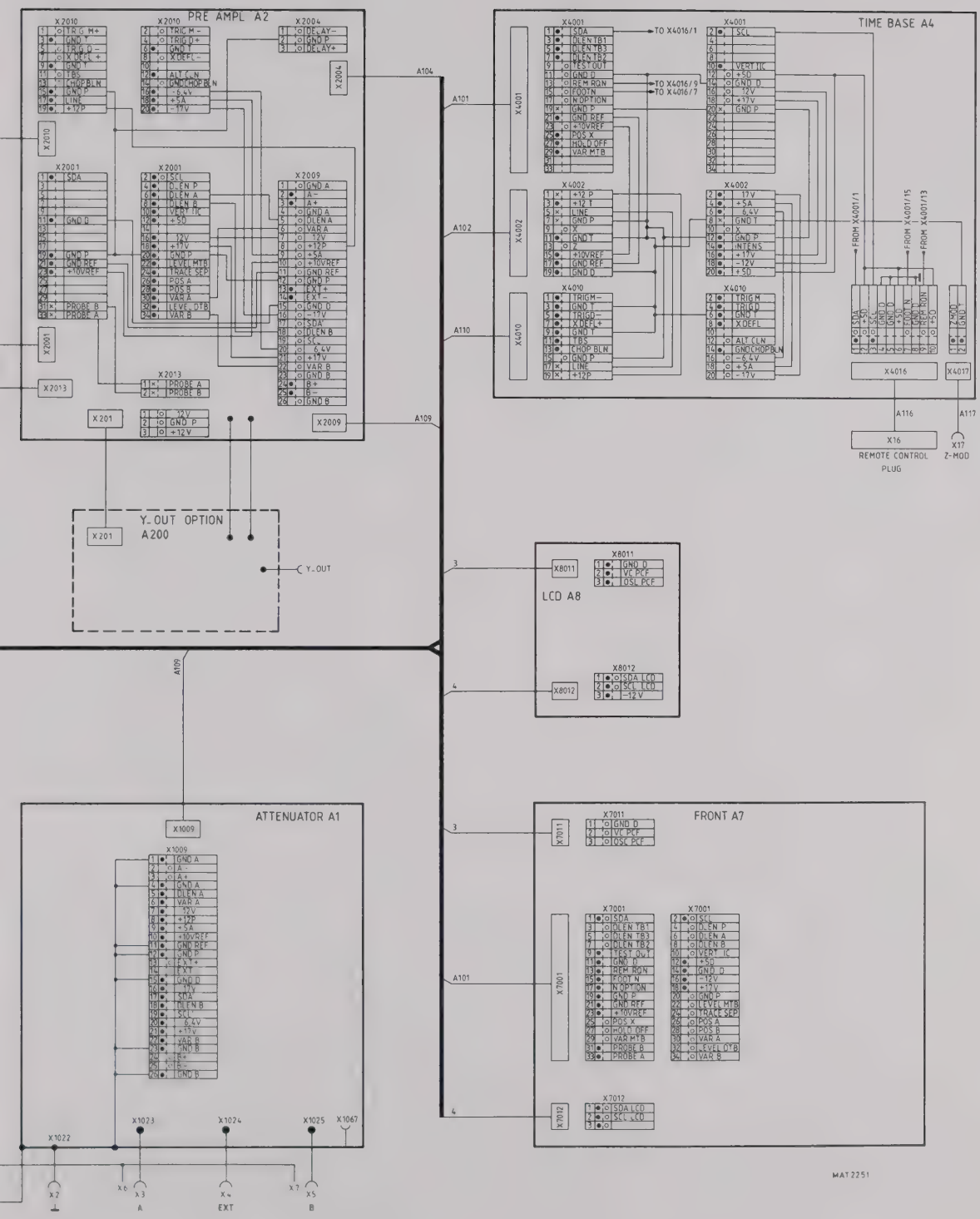


Figure 14.5 Pcb interconnections

The Trimming Kit contains the following parts:

Figure 14.6 Trimming tool kit

14.6.2 Pcb snapper 5322 535 91942

A special tool is available for removal of the pcb from the pcb supports. Information on how to use this tool is given in Chapter 14.2.
The ordering number of this tool is 5322 535 91942

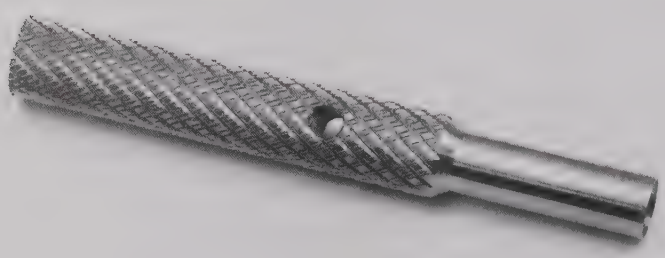


Figure 14.7 Pcb snapper

14.7 RECALIBRATION AFTER REPAIR

After any electrical component has been renewed the calibration of its associated circuit should be checked, as well as the calibration of other closely-related circuits.
Since the power supply affects all circuits, calibration of the entire instrument should be checked it work has been done in the power supply or if the transformer has been renewed.

15. SAFETY INSPECTION AND TEST AFTER REPAIR AND MAINTENANCE IN THE PRIMARY CIRCUIT

15.1 GENERAL DIRECTIVES

- Take care that the creepage distances and clearances have not been reduced.
- Before soldering, the wires should be bent through the holes of solder tags, or wrapped around the tag in the form of an open U, or, wiring ridigity shall be maintained by cable clamps or cable lacing.
- Replace all insulating guards and -plates.

15.2 SAFETY COMPONENTS

Components in the primary circuit may only be renewed by components selected by Philips, see also Section 14.1.2.

15.3 CHECKING THE PROTECTIVE EARTH CONNECTION

The correct connection and condition is checked by visual control and by measuring the resistance between the protective lead connection at the plug and the cabinet/frame. The resistance shall not be more than 0,1 Ohm. During measurement the mains cable should be removed from the mains. Resistance variations indicate a defect.

15.4 CHECKING THE INSULATION RESISTANCE

Measure the insulation resistance at U = 500 V dc between the mains connections and the protective lead connections. For this purpose, set the mains switch to ON. The insulation resistance shall not be less than 2 Meg-ohm.

NOTE: 2 Meg-ohm is a minimum requirement at 40^{o}C and 95 % Relative Humidity. Under normal conditions the insulation resistance should be much higher (10 ... 20 Meg-ohm).

15.5 CHECKING THE LEAKAGE CURRENT

The leakage current shall be measured between each pole of the mains supply in turn, and all accessible conductive parts connected together (including the measuring earth terminal).
The leakage current is not excessive if the measured currents from the mentioned parts does not exceed 3,5 mA rms.

15.6 VOLTAGE TEST

The instrument shall withstand, without electrical breakdown, the application of a test voltage between the supply circuit and accessible conductive parts that are likely to become energized. The test potential shall be 1500 V rms at supply-circuit frequency, applied for one second.
The test shall be conducted when the instrument is fully assembled, and with the primary switch in the ON position.
During the test, both sides of the primary circuit of the instrument are connected together and to one terminal of the voltage test equipment; the other voltage test equipment terminal is connected to the accessible conductive parts.

16. PARTS LIST

(subject to alteration without notice)

16.1 MECHANICAL PARTS

16.1.1 Mechanical parts indicated in figure 16.1.

Item	Qty	Ordering code	Description
1	1	5322 381 10779	Bezel
2	1	5322 480 30181	Contrast filter blue
3	1	5322 455 81029	Textfilm on bezel
4	1	5322 268 14052	CAL socket
5	1	4822 530 70296	Clamping spring for CAL socket
6	13	5322 414 10018	Control knob with spring
7	1	5322 464 90252	Front frame
8	1	5322 455 81026	Textfilm CRT unit
9	1	5322 455 81025	Textfilm for handle
10	1	5322 498 50219	Handle assembly
11	1	5322 414 60142	Power-on knob, green-brown
12	2	5322 492 63355	Spring for handle
13	1	5322 535 80735	Extension part for power-on switch
14	1	5322 464 90248	Upper cabinet
15	2	5322 462 10264	Pcb guiding for A6
16	2	5322 462 10265	Pcb support for A3
17	1	5322 464 90251	Chassis
18	6	5322 462 30304	Pcb support
19	1	5322 464 90249	Bottom cabinet
20	2	5322 464 90253	Attenuator cover
21	4	5322 462 50325	Bottom foot
22	3	5322 532 21188	BNC spacer ring
23	3	5322 532 21189	BNC extension bush
24	3	5322 267 10004	BNC socket
25	1	5322 464 90254	Front unit frame
26	1	5322 455 81028	Textfilm for front unit
27	18	5322 276 11856	Softkey brown
28	2	5322 276 11858	Softkey beige
29	1	5322 276 11857	Softkey green
30	2	5322 277 10879	UP-DOWN key beige
31	3	5322 277 10878	UP-DOWN key brown
32	2	5322 492 63354	Range indication spring

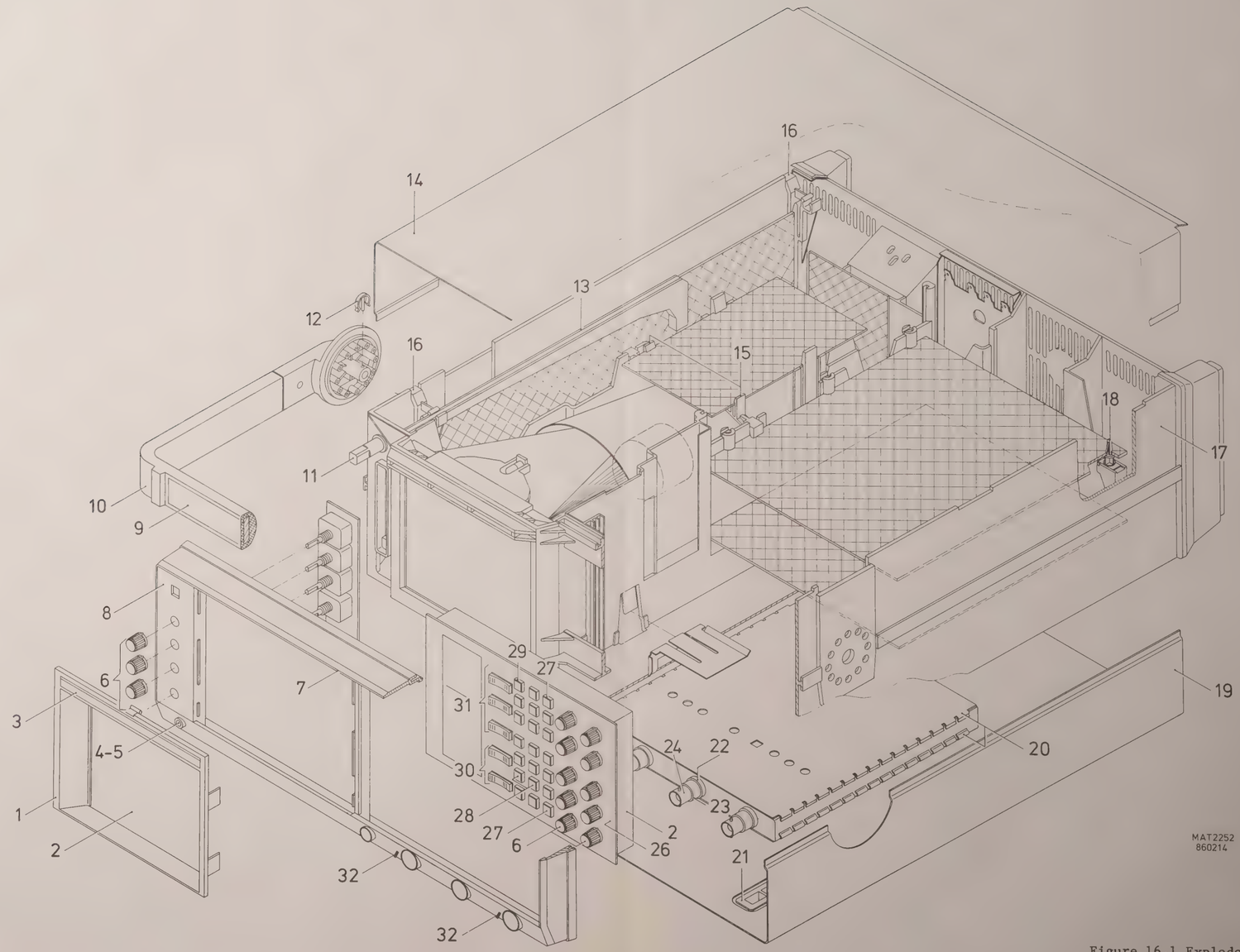


Figure 16.1 Exploded view

Figure 16.2 Rear view

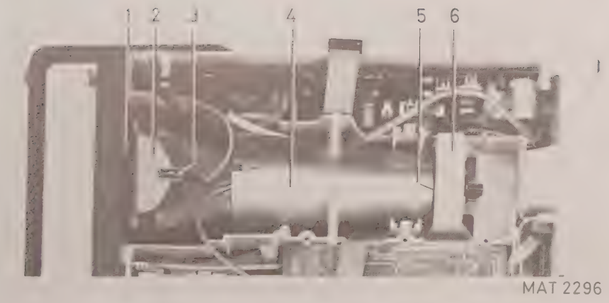


Figure 16.3 Inside view showing the parts in the CRT compartiment

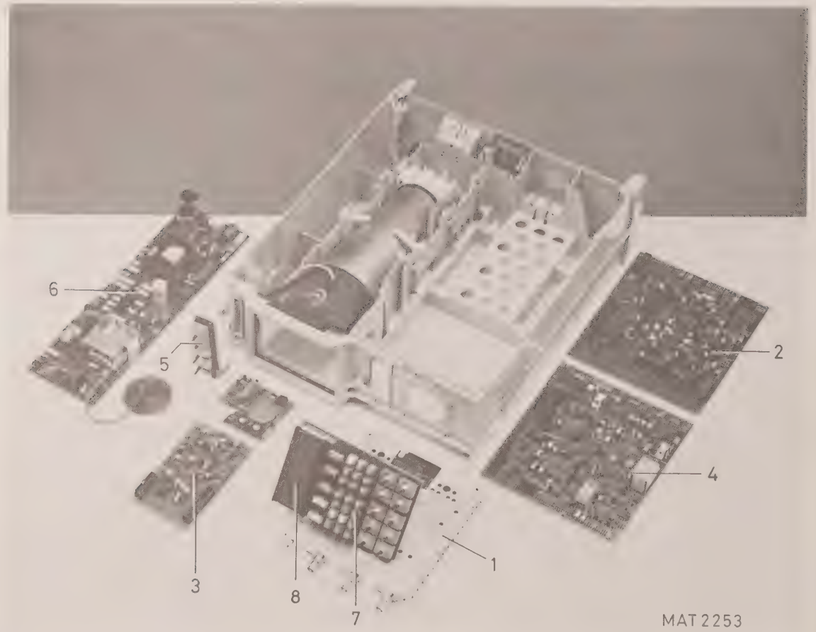


Figure 16.4 View of the units

16.1.2 Mechanical parts indicated in figure 16.2

Item	Qty	Ordering code	Description
1	2	5322 462 50324	Rear foot
2	1	5322 267 10004	BNC socket for Z-MOD
3	2	5322 535 30075	Snap rivet for Remote control socket
4	1	5322 321 21596	Remote control socket, incl. cable
5	1	5322 321 21616	Line cable, European version
	1	---	Line cable, USA version
	1	5322 321 21617	Line cable, British version
	1	5322 321 21618	Line cable, Swiss version
	1	---	Line cable, Australean version
6	1	5322 265 30432	Mains input socket, incl. fuse holder
7	1	4822 253 30024	Fuse 1,6A (for mains input)

16.1.3 Mechanical parts indicated in figure 16.3

Item	Qty	Ordering code	Description
1	1	5322 460 60404	CRT front rubber
2	1	5322 462 40957	Light conductor for CRT
3	1	5322 134 40534	Lamp 28V-40mA
4	1	5322 466 30163	CRT shielding
5	1	5322 466 30164	CRT manchet, rubber
6	1	5322 462 10263	CRT support

16.2 UNITS (see figure 16.4)

Item	Unit nr.	Ordering code	Description
1	A1	5322 216 51114	Attenuator unit
2	A2	5322 216 51116	Pre-amplifier unit
3	A3	5322 216 51117	XYZ-amplifier unit
4	A4	5322 216 51115	Time-base unit
5	A5	5322 216 51118	CRT-control unit
6	A6	5322 216 51119	Power supply unit
7	A7	5322 216 51113	Front unit
8	A8	5322 216 51121	LCD unit

16.3 CABLES AND CONNECTORS

16.3.1 Flatcables and connectors

For the flatcables used in this oscilloscope, the required version must be made by yourself with the following parts:

- Universal flatcable, 40 wires, length 60 cm 5322 323 50112

To get the required number of wires, the flat cable must be split by means of a pair of scissors or a knife.
The cable must be cut to the required length.

- Flatcable connectors

The connectors can be mounted on the flatcable by means of a pair of pliers or in a bench-vice.
Attention: check the position of the flatcable in the connector before pressing the connector together.

The following connectors are available:

10 pole cable connector X4016-X5007-X6007
20 pole cable connector X2010-X3002-X3003-X4002-X4010-X6009
26 pole cable connector X1009-X2009
34 pole cable connector X2001-X4001-X7001

The following AMP-connectors are available:

2 pole-single, without contact pins
3 pole-single, without contact pins
bus contact for AMP-cable connector, per piece:
5 pole connector for power-in:
bus contact for connector, per piece:

16.3.2 Pcb-connectors (male headers)

Type	Item	Ordering number
2 pole-single	X2013-X4017-X6020	5322 265 20275
3 pole-single	X6006-X6019	5322 265 30434
3 pole-single	X6018 (power supply)	5322 265 40435
3 pole-single 90° type	X2004-X3004-X3005-X3008	5322 265 30433
5 pole-single	X6014	5322 265 40436
10 pole-double	X4016-X5007-X6007	5322 265 40485
20 pole-double	X2010-X3002-X3003 X4002-X4010-X6003	5322 265 51129
26 pole-double	X1009-X2009	5322 265 61071
34 pole-double	X2001-X4001	5322 265 61069
34 pole-double 90° type	X7001	5322 265 61068
CRT-socket	X3006	5322 255 40502

16.3.3 Miscellaneous cables

- Delay line cable, 54 cm long 5322 321 21595
- Flex jump cable, used for interconnection for A3 - 11 pole. 5322 290 60605

16.4 Electrical parts

16.4.1 Capacitors

POSNR	DESCRIPTION		ORDERING CODE
C 1001	-20+50%	10NF	4822 122 31414
C 1002	400V 10%	22NF	5322 121 40308
C 1003	-20+50%	10NF	4822 122 31414
C 1004	-20+50%	10NF	4822 122 31414
C 1006	-20+50%	10NF	4822 122 31414
C 1007	0.25PF	1PF	5322 122 32773
C 1009	2%	33PF	5322 122 32072
C 1011	63V 10%	220NF	5322 121 42493
C 1012	63V 10%	220NF	5322 121 42493
C 1013	2%	15PF	4822 122 31823
C 1014	0.25PF	0.56PF	5322 122 32107
C 1016	0.25PF	3.3PF	5322 122 32549
C 1017	0.25PF	3.3PF	4822 122 31821
C 1018	0.25PF	2.2PF	5322 122 32774
C 1019	2%	33PF	5322 122 32072
C 1021	-20+50%	10NF	4822 122 31414
C 1022	2%	27PF	4822 122 30045
C 1024	-20+50%	10NF	4822 122 31414
C 1026	0.25PF	3.3PF	5322 122 32549
C 1027	0.25PF	1.8PF	4822 122 31185
C 1028	2%	33PF	5322 122 32072
C 1031	-20+50%	10NF	4822 122 31414
C 1032	2%	33PF	5322 122 32551
C 1034	-20+50%	10NF	4822 122 31414
C 1035	-20+50%	10NF	4822 122 31414
C 1036	2%	33PF	5322 122 32072
C 1037	2%	22PF	5322 122 32143
C 1038	2%	100PF	4822 122 31316
C 1039	0.25PF	2.7PF	4822 122 31038
C 1040	2%	100PF	4822 122 31316
C 1041	-20+50%	10NF	4822 122 31414
C 1042	-20+50%	10NF	4822 122 31414
C 1043	-20+50%	10NF	4822 122 31414
C 1044	-20+50%	10NF	4822 122 31414
C 1045	-20+50%	10NF	4822 122 31414
C 1046	-10+50%	68UF	4822 124 20689
C 1047	2%	3.9PF	5322 122 34107
C 1061	10%	470PF	4822 122 30034
C 1062	0.25PF	3.3PF	4822 122 31821
C 1063	2%	33PF	5322 122 32072
C 1064	10%	680PF	4822 122 30053
C 1066	2%	18PF	4822 122 31061
C 1067	2%	68PF	4822 122 31349
C 1068	-20+50%	10NF	4822 122 31414
C 1069	-20+50%	10NF	4822 122 31414
C 1071	-20+50%	10NF	4822 122 31414
C 1072	-20+50%	10NF	4822 122 31414
C 1074	-20+50%	10NF	4822 122 31414
C 1076	10%	1.5NF	4822 122 31169
C 1077	10%	1.5NF	4822 122 31169
C 1101	-20+50%	10NF	4822 122 31414
C 1102	400V 10%	22NF	5322 121 40308
C 1103	-20+50%	10NF	4822 122 31414
C 1104	-20+50%	10NF	4822 122 31414
C 1106	-20+50%	10NF	4822 122 31414
C 1107	0.25PF	1PF	5322 122 32773
C 1109	2%	33PF	5322 122 32072

POSNR	DESCRIPTION	ORDERING CODE
C 1111	63V 10% 220NF	5322 121 42493
C 1112	63V 10% 220NF	5322 121 42493
C 1113	2% 15PF	4822 122 31823
C 1114	0.25PF 0.56F	5322 122 32107
C 1116	0.25PF 3.3PF	5322 122 32549
C 1117	0.25PF 3.3PF	4822 122 31821
C 1118	0.25PF 2.2PF	5322 122 32774
C 1119	2% 33PF	5322 122 32072
C 1121	-20+50% 10NF	4822 122 31414
C 1122	2% 27PF	5322 122 32776
C 1124	-20+50% 10NF	4822 122 31414
C 1126	0.25PF 3.3PF	5322 122 32549
C 1127	0.25PF 1.8PF	4822 122 31185
C 1128	2% 33PF	5322 122 32072
C 1131	-20+50% 10NF	4822 122 31414
C 1132	2% 33PF	5322 122 32551
C 1134	-20+50% 10NF	4822 122 31414
C 1135	-20+50% 10NF	4822 122 31414
C 1136	2% 33PF	5322 122 32072
C 1137	2% 22PF	5322 122 32143
C 1138	2% 100PF	4822 122 31316
C 1139	0.25PF 2.7PF	4822 122 31038
C 1140	2% 100PF	4822 122 31316
C 1141	-20+50% 10NF	4822 122 31414
C 1142	-20+50% 10NF	4822 122 31414
C 1143	-20+50% 10NF	4822 122 31414
C 1144	-20+50% 10NF	4822 122 31414
C 1145	-20+50% 10NF	4822 122 31414
C 1146	-10+50% 68UF	4822 124 20689
C 1147	2% 3.9PF	5322 122 34107
C 1161	10% 470PF	4822 122 30034
C 1162	0.25PF 3.3PF	4822 122 31821
C 1163	2% 33PF	5322 122 32072
C 1164	10% 680PF	4822 122 30053
C 1166	2% 18PF	4822 122 31061
C 1167	2% 68PF	4822 122 31349
C 1168	-20+50% 10NF	4822 122 31414
C 1169	-20+50% 10NF	4822 122 31414
C 1171	-20+50% 10NF	4822 122 31414
C 1172	-20+50% 10NF	4822 122 31414
C 1174	-20+50% 10NF	4822 122 31414
C 1176	10% 1.5NF	4822 122 31169
C 1177	10% 1.5NF	4822 122 31169
C 1201	-20+50% 10NF	4822 122 31414
C 1202	400V 10% 22NF	5322 121 40308
C 1203	2% 33PF	5322 122 32551
C 1204	0.25PF 5.6PF	5322 122 32775
C 1207	2% 22PF	5322 122 32143
C 1208	-20+50% 10NF	4822 122 31414
C 1211	-20+50% 10NF	4822 122 31414
C 1212	2% 100PF	4822 122 31316
C 1213	0.25PF 01.8PF	5322 122 32162
C 1216	0.25PF 4.7PF	4822 122 31822
C 1217	-20+50% 10NF	4822 122 31414
C 1401	-20+50% 10NF	4822 122 31414
C 1402	-20+50% 10NF	4822 122 31414
C 1403	-20+50% 10NF	4822 122 31414
C 1404	-10+50% 68UF	4822 124 20689
C 1407	-20+50% 10NF	4822 122 31414
C 1408	-20+50% 10NF	4822 122 31414
C 1409	-10+50% 68UF	4822 124 20689
C 1411	-20+50% 10NF	4822 122 31414
C 1412	-20+50% 10NF	4822 122 31414
C 1413	-10+50% 47UF	4822 124 20699
C 1414	-20+50% 10NF	4822 122 31414

POSNR	DESCRIPTION	ORDERING CODE
C 1421	-20+50% 10NF	4822 122 31414
C 1422	-20+50% 10NF	4822 122 31414
C 1423	-20+50% 10NF	4822 122 31414
C 1424	-10+50% 68UF	4822 124 20689
C 1427	-20+50% 10NF	4822 122 31414
C 1428	-20+50% 10NF	4822 122 31414
C 1429	-10+50% 68UF	4822 124 20689
C 1431	-20+50% 10NF	4822 122 31414
C 1432	-20+50% 10NF	4822 122 31414
C 1433	-10+50% 47UF	4822 124 20699
C 1434	-20+50% 10NF	4822 122 31414
C 1441	-20+50% 10NF	4822 122 31414
C 1442	-10+50% 68UF	4822 124 20689
C 1443	-20+50% 10NF	4822 122 31414
C 1444	-20+50% 10NF	4822 122 31414
C 1446	-10+50% 68UF	4822 124 20689
C 1447	-20+50% 10NF	4822 122 31414
C 2049	10% 470PF	4822 122 30034
C 2050	-20+50% 10NF	4822 122 31414
C 2051	10% 470PF	4822 122 30034
C 2149	10% 470PF	4822 122 30034
C 2150	-20+50% 10NF	4822 122 31414
C 2151	10% 470PF	4822 122 30034
C 2201	-20+50% 10NF	4822 122 31414
C 2203	-20+50% 10NF	4822 122 31414
C 2207	-20+50% 10NF	4822 122 31414
C 2215	0.25PF 3.9PF	5322 122 34107
C 2216	0.25PF 2.7PF	4822 122 31038
C 2217	-20+50% 10NF	4822 122 31414
C 2218	0.25PF 2.7PF	4822 122 31038
C 2221	10% 470PF	4822 122 30034
C 2222	0.25PF 8.2PF	4822 122 31052
C 2223	10% 470PF	4822 122 30034
C 2224	10% 470PF	4822 122 30034
C 2225	2% 100PF	4822 122 31316
C 2226	2% 100PF	4822 122 31316
C 2305	-20+50% 10NF	4822 122 31414
C 2306	10% 1.5NF	4822 122 31169
C 2307	10% 1.5NF	4822 122 31169
C 2317	0.25PF 1.5PF	5322 122 32101
C 2318	10% 470PF	4822 122 30034
C 2321	0.25PF 1.5PF	5322 122 32101
C 2326	-20+50% 10NF	4822 122 31414
C 2327	-20+50% 10NF	4822 122 31414
C 2328	63V 10% 100NF	5322 121 42492
C 2329	63V 10% 100NF	5322 121 42492
C 2331	63V 10% 100NF	5322 121 42492
C 2332	63V 10% 100NF	5322 121 42492
C 2333	63V 10% 100NF	5322 121 42492
C 2335	2% 12PF	4822 122 31056
C 2336	-20+50% 10NF	4822 122 31414
C 2337	-20+50% 10NF	4822 122 31414
C 2342	2% 22PF	5322 122 32143
C 2345	0.25PF 1.2PF	5322 122 32312
C 2346	10% 470PF	4822 122 30034
C 2348	10% 470PF	4822 122 30034
C 2350	0.25PF 27PF	4822 122 31038
C 2507	-20+50% 10NF	4822 122 31414
C 2510	2% 22PF	5322 122 32143
C 2516	0.25PF 2.7PF	4822 122 31038
C 2517	10% 470PF	4822 122 30034
C 2518	0.25PF 2.7PF	4822 122 31038
C 2519	2% 15PF	4822 122 31823
C 2600	2% 22PF	5322 122 32143
C 2601	63V 10% 100NF	5322 121 42492

POSNR	DESCRIPTION	ORDERING CODE
C 2602	-20+50% 10NF	4822 122 31414
C 2611	10% 1NF	4822 122 30027
C 2612	-20+50% 10NF	4822 122 31414
C 2613	10% 470PF	4822 122 30034
C 2616	2% 100PF	4822 122 31316
C 2701	-10+50% 100UF	4822 124 20679
C 2702	-20+50% 10NF	4822 122 31414
C 2703	-20+50% 10NF	4822 122 31414
C 2704	-20+50% 10NF	4822 122 31414
C 2706	-10+50% 100UF	4822 124 20679
C 2707	-20+50% 10NF	4822 122 31414
C 2708	-20+50% 10NF	4822 122 31414
C 2709	-20+50% 10NF	4822 122 31414
C 2711	-20+50% 10NF	4822 122 31414
C 2716	-10+50% 68UF	4822 124 20689
C 2717	-20+50% 10NF	4822 122 31414
C 2718	-20+50% 10NF	4822 122 31414
C 2722	-20+50% 10NF	4822 122 31414
C 2726	-10+50% 68UF	4822 124 20689
C 2727	-20+50% 10NF	4822 122 31414
C 2728	-20+50% 10NF	4822 122 31414
C 2741	-20+50% 10NF	4822 122 31414
C 2744	-20+50% 10NF	4822 122 31414
C 2746	-20+50% 10NF	4822 122 31414
C 2747	-10+50% 68UF	4822 124 20689
C 2748	-20+50% 10NF	4822 122 31414
C 2751	-10+50% 47UF	4822 124 20699
C 2752	-20+50% 10NF	4822 122 31414
C 2753	-20+50% 10NF	4822 122 31414
C 2754	-20+50% 10NF	4822 122 31414
C 2761	-20+50% 10NF	4822 122 31414
C 2762	-20+50% 10NF	4822 122 31414
C 2764	-20+50% 10NF	4822 122 31414
C 2771	-20+50% 10NF	4822 122 31414
C 2772	-10+50% 150UF	4822 124 20672
C 2773	-20+50% 10NF	4822 122 31414
C 2774	-10+50% 68UF	4822 124 20689
C 2776	-20+50% 10NF	4822 122 31414
C 2777	63V 10% 100NF	5322 121 42492
C 2781	-20+50% 10NF	4822 122 31414
C 3001	-20+50% 10NF	4822 122 31414
C 3002	10% 470PF	4822 122 30034
C 3003	10% 470PF	4822 122 30034
C 3004	2-20PF MUR	5322 125 50296
C 3005	2% 10PF	4822 122 32185
C 3006	0.25PF 5.6PF	5322 122 32163
C 3008	0.25PF 8.2PF	4822 122 31052
C 3009	2% 15PF	4822 122 31823
C 3011	2% 27PF	4822 122 30045
C 3013	0.25PF 2.7PF	4822 122 31038
C 3014	0.25PF 2.7PF	4822 122 31038
C 3016	2-20PF MUR	5322 125 50296
C 3017	-20+50% 10NF	4822 122 31414
C 3018	0.25PF 5.6PF	5322 122 32163
C 3021	-20+50% 10NF	4822 122 31414
C 3022	-20+50% 10NF	4822 122 31414
C 3101	-20+50% 10NF	4822 122 31414
C 3102	-20+50% 10NF	4822 122 31414
C 3104	47NF 10% 100V	5322 121 42491
C 3105	-20+50% 10NF	4822 122 31414

POSNR	DESCRIPTION	ORDERING CODE
C 3106	63V 10% 100NF	5322 121 42492
C 3108	0.25PF 0.82PF	4822 122 31214
C 3109	63V 10% 100NF	5322 121 42492
C 3110	-20+50% 10NF	4822 122 31414
C 3111	-20+50% 10NF	4822 122 31414
C 3112	2% 100PF	4822 122 31316
C 3113	0.25PF 0.82PF	4822 122 31214
C 3114	47NF 10% 100V	5322 121 42491
C 3116	63V 10% 100NF	5322 121 42492
C 3200	0.25PF 0.56PF	5322 122 32107
C 3201	0.25PF 0.56PF	5322 122 32107
C 3202	63V 10% 100NF	5322 121 42492
C 3203	63V 10% 100NF	5322 121 42492
C 3204	-20+50% 10NF	4822 122 31414
C 3206	63V 10% 100NF	5322 121 42492
C 3208	10% 470PF	4822 122 30034
C 3209	-20+50% 2.2NF	5322 122 50093
C 3211	-20+50% 2.2NF	5322 122 50093
C 3250	100V 10% 10NF	5322 121 42495
C 3251	47NF 10% 100V	5322 121 42491
C 3252	-20+50% 2.2NF	5322 122 50093
C 3253	-20+50% 10NF	4822 122 31414
C 3254	-20+50% 10NF	4822 122 31414
C 3257	-20+50% 10NF	4822 122 31414
C 3258	-20+50% 2.2NF	5322 122 50093
C 3259	0.25PF 0.82PF	4822 122 31214
C 3301	-20+50% 10NF	4822 122 31414
C 3302	-20+50% 10NF	4822 122 31414
C 3303	-10+50% 47UF	4822 124 20699
C 3304	-20+50% 10NF	4822 122 31414
C 3305	10% 1.5NF	4822 122 31169
C 3306	-20+50% 10NF	4822 122 31414
C 3307	-20+50% 10NF	4822 122 31414
C 3308	-20+50% 10NF	4822 122 31414
C 3309	-20+50% 10NF	4822 122 31414
C 3310	10% 1.5NF	4822 122 31169
C 3311	-20+50% 10NF	4822 122 31414
C 3312	-10+50% 47UF	4822 124 20699
C 3313	-20+50% 10NF	4822 122 31414
C 3314	-10+50% 15UF	4822 124 20729
C 3316	-20+50% 10NF	4822 122 31414
C 3317	-20+50% 10NF	4822 122 31414
C 3318	-20+50% 10NF	4822 122 31414
C 3319	-10+50% 15UF	4822 124 20729
C 3321	-20+50% 10NF	4822 122 31414
C 3322	-20+50% 10NF	4822 122 31414
C 3324	-20+50% 10NF	4822 122 31414
C 3326	-20+50% 10NF	4822 122 31414
C 4001	63V 10% 100NF	5322 121 42492
C 4002	-10+50% 47UF	4822 124 20699
C 4004	-20+50% 10NF	4822 122 31414
C 4005	-20+50% 10NF	4822 122 31414
C 4006	10% 4.7NF	4822 122 31125
C 4007	10% 4.7NF	4822 122 31125
C 4008	10% 470PF	4822 122 30034
C 4009	0.25PF 3.9PF	5322 122 34107
C 4011	2% 100PF	4822 122 31316
C 4021	-10+50% 47UF	4822 124 20699
C 4022	-20+50% 10NF	4822 122 31414
C 4023	-20+50% 10NF	4822 122 31414
C 4024	2% 47PF	4822 122 31072
C 4026	0.25PF 3.9PF	5322 122 34107
C 4027	2% 100PF	4822 122 31316
C 4028	2% 100PF	4822 122 31316
C 4029	2% 100PF	4822 122 31316

POSNR	DESCRIPTION	ORDERING CODE
C 4101	-20+50% 10NF	4822 122 31414
C 4103	-20+50% 10NF	4822 122 31414
C 4105	63V 10% 100NF	5322 121 42492
C 4106	-10+50% 150UF	4822 124 20672
C 4107	-20+50% 10NF	4822 122 31414
C 4108	2% 100PF	4822 122 31316
C 4109	-20+50% 10NF	4822 122 31414
C 4110	2% 100PF	4822 122 31316
C 4112	-20+50% 10NF	4822 122 31414
C 4113	630V 1% 1NF	5322 121 50998
C 4113	630V 1% 1NF	4822 121 50591
C 4114	100V 10% 10UF	5322 121 41727
C 4115	2% 10PF	4822 122 32185
C 4116	10% 4.7NF	4822 122 31125
C 4117	2% 100PF	4822 122 31316
C 4118	-20+50% 10NF	4822 122 31414
C 4122	63V 10% 100NF	5322 121 42492
C 4123	-10+50% 47UF	4822 124 20699
C 4124	-20+50% 10NF	4822 122 31414
C 4126	-10+50% 47UF	4822 124 20699
C 4127	2% 100PF	4822 122 31316
C 4201	-20+50% 10NF	4822 122 31414
C 4209	-20+50% 10NF	4822 122 31414
C 4210	2% 10PF	4822 122 32185
C 4212	-20+50% 10NF	4822 122 31414
C 4213	630V 1% 1NF	5322 121 50998
C 4214	63V 10% 100NF	5322 121 42492
C 4216	10% 4.7NF	4822 122 31125
C 4217	2% 100PF	4822 122 31316
C 4301	63V 10% 100NF	5322 121 42492
C 4302	-10+50% 15UF	4822 124 20729
C 4303	-20+50% 10NF	4822 122 31414
C 4304	10% 470PF	4822 122 30034
C 4311	2% 100PF	4822 122 31316
C 4312	2% 100PF	4822 122 31316
C 4313	630V 1% 1NF	4822 121 50591
C 4400	10% 1NF	4822 122 30027
C 4401	-20+50% 10NF	4822 122 31414
C 4402	10% 1NF	4822 122 30027
C 4403	63V 10% 100NF	5322 121 42492
C 4404	63V 10% 100NF	5322 121 42492
C 4405	-20+50% 10NF	4822 122 31414
C 4406	63V 10% 100NF	5322 121 42492
C 4407	63V 10% 100NF	5322 121 42492
C 4408	63V 10% 100NF	5322 121 42492
C 4409	-20+50% 10NF	4822 122 31414
C 4411	-20+50% 10NF	4822 122 31414
C 4412	-20+50% 10NF	4822 122 31414
C 4413	-20+50% 10NF	4822 122 31414
C 4414	-20+50% 10NF	4822 122 31414
C 4416	10% 680PF	4822 122 30053
C 4418	63V 10% 100NF	5322 121 42492
C 4419	-20+50% 10NF	4822 122 31414
C 4421	63V 10% 100NF	5322 121 42492
C 4501	-20+50% 10NF	4822 122 31414
C 4502	-20+50% 10NF	4822 122 31414
C 4503	0.25PF 3.9PF	5322 122 34107
C 4521	63V 10% 100NF	5322 121 42492
C 4522	63V 10% 100NF	5322 121 42492
C 4601	63V 10% 100NF	5322 121 42492

POSNR	DESCRIPTION	ORDERING CODE
C 4602	0.25PF 8.2PF	4822 122 31052
C 4603	0.25PF 8.2PF	4822 122 31052
C 4611	-20+50% 10NF	4822 122 31414
C 4612	-20+50% 10NF	4822 122 31414
C 4613	2% 10PF	4822 122 32185
C 4701	10% 470PF	4822 122 30034
C 4702	63V 10% 100NF	5322 121 42492
C 4703	10% 470PF	4822 122 30034
C 4704	-20+50% 10NF	4822 122 31414
C 4804	-10+50% 150UF	4822 124 20672
C 4807	-20+50% 10NF	4822 122 31414
C 4808	-10+50% 68UF	4822 124 20689
C 4811	-20+50% 10NF	4822 122 31414
C 4812	-10+50% 47UF	4822 124 20699
C 4813	-20+50% 10NF	4822 122 31414
C 4816	-20+50% 10NF	4822 122 31414
C 4817	-20+50% 10NF	4822 122 31414
C 4818	-20+50% 10NF	4822 122 31414
C 4819	-20+50% 10NF	4822 122 31414
C 4820	-20+50% 10NF	4822 122 31414
C 4821	-20+50% 10NF	4822 122 31414
C 4822	-20+50% 10NF	4822 122 31414
C 4824	-20+50% 10NF	4822 122 31414
C 4825	-20+50% 10NF	4822 122 31414
C 4826	-20+50% 10NF	4822 122 31414
C 4828	-20+50% 10NF	4822 122 31414
C 4829	-20+50% 10NF	4822 122 31414
C 4830	-20+50% 10NF	4822 122 31414
C 4831	-20+50% 10NF	4822 122 31414
C 4833	-20+50% 10NF	4822 122 31414
C 4835	-20+50% 10NF	4822 122 31414
C 4836	-20+50% 10NF	4822 122 31414
C 4837	-10+50% 47UF	4822 124 20699
C 4838	-10+50% 47UF	4822 124 20699
C 4839	2% 47PF	4822 122 31072
C 4841	2% 47PF	4822 122 31072
C 5001	-20+50% 10NF	4822 122 31414
C 5002	-20+50% 10NF	4822 122 31414
C 5003	-20+50% 10NF	4822 122 31414
C 5004	-20+50% 10NF	4822 122 31414
C 5006	-20+50% 10NF	4822 122 31414
C 6001	250V 10% 220NF	5322 121 44142
C 6002	ME275 20% 1NF	5322 121 42583
C 6003	63V 10% 100NF	5322 121 42492
C 6004	63V 10% 100NF	5322 121 42492
C 6005	-20+50% 1.5NF	5322 122 50092
C 6006	ME275 20% 1NF	5322 121 42583
C 6007	-20+20% 68UF	5322 124 21938
C 6007	-10+50% 68UF	5322 124 21937
C 6008	-20+20% 68UF	5322 124 21938
C 6008	-10+50% 68UF	5322 124 21937
C 6009	63V 10% 100NF	5322 121 42492
C 6011	-10+50% 33UF	4822 124 20712
C 6012	2% 220PF	4822 122 30094
C 6014	160V 1% 33NF	5322 121 50997
C 6016	630V 1% 470PF	5322 121 50999
C 6016	630V 1% 470PF	5322 121 54078
C 6017	630V 1% 1NF	5322 121 50998
C 6017	630V 1% 1NF	4822 121 50591
C 6031	2% 22PF	5322 122 32143
C 6032	100V 10% 22NF	5322 121 42496
C 6041	63V 10% 100NF	5322 121 42492
C 6042	63V 10% 100NF	5322 121 42492
C 6100	20% 6800UF	4822 124 40692
C 6101	20% 6800UF	4822 124 40692

POSNR	DESCRIPTION	ORDERING CODE
C 6102	-10+50% 680UF	4822 124 20685
C 6103	-10+50% 470UF	4822 124 20684
C 6104	-10+50% 220UF	4822 124 20681
C 6106	-10+50% 470UF	4822 124 20695
C 6107	-10+50% 150UF	4822 124 20691
C 6108	-10+50% 470UF	4822 124 20695
C 6109	-10+50% 150UF	4822 124 20691
C 6111	-10+50% 220UF	4822 124 20704
C 6112	-10+50% 100UF	4822 124 20701
C 6113	-10+50% 100UF	4822 124 20701
C 6114	-10+50% 100UF	4822 124 20701
C 6116	-10+50% 68UF	4822 124 20734
C 6117	-10+50% 22UF	4822 124 20731
C 6119	-10+50% 22UF	4822 124 20731
C 6120	-20+50% 10NF	4822 122 31414
C 6121	-10+50% 22UF	4822 124 20731
C 6131	-10+50% 33UF	4822 124 20712
C 6132	-10+50% 100UF	4822 124 20679
C 6133	63V 10% 100NF	5322 121 42492
C 6201	47NF 10% 100V	5322 121 42491
C 6202	2% 47PF	4822 122 31072
C 6204	63V 10% 100NF	5322 121 42492
C 6206	10% 1NF	4822 122 30027
C 6207	10% 4.7NF	4822 122 31125
C 6208	-10+50% 68UF	4822 124 20734
C 6209	-20+50% 2.2NF	5322 122 50093
C 6211	-20+50% 10NF	5322 122 50091
C 6213	10% 4.7NF	4822 122 31125
C 6311	-20+50% 10NF	4822 122 31414
C 6401	63V 10% 100NF	5322 121 42492
C 6402	-10+50% 68UF	4822 124 20689
C 6500	-10+50% 68UF	4822 124 20689
C 6501	-20+50% 10NF	4822 122 31414
C 6502	100V 10% 10NF	5322 121 42495
C 6503	2% 100PF	4822 122 31316
C 6506	2% 100PF	4822 122 31316
C 7001	63V 10% 220NF	5322 121 42493
C 7002	2% 39PF	4822 122 31069
C 7003	2% 39PF	4822 122 31069
C 7004	-20+50% 10NF	4822 122 31414
C 7005	63V 10% 100NF	5322 121 42492
C 7006	-20+50% 10NF	4822 122 31414
C 7007	63V 10% 100NF	5322 121 42492
C 7008	10% 680PF	4822 122 30053
C 7009	63V 10% 100NF	5322 121 42492
C 7011	-20+50% 10NF	4822 122 31414
C 7012	-20+50% 10NF	4822 122 31414
C 7013	-20+50% 10NF	4822 122 31414
C 7014	-20+50% 10NF	4822 122 31414
C 7016	-20+50% 10NF	4822 122 31414
C 7017	-20+50% 10NF	4822 122 31414
C 7018	-20+50% 10NF	4822 122 31414
C 7019	-20+50% 10NF	4822 122 31414
C 7021	-20+50% 10NF	4822 122 31414
C 7022	-20+50% 10NF	4822 122 31414
C 7100	-20+50% 10NF	4822 122 31414
C 7101	-20+50% 10NF	4822 122 31414
C 7102	-20+50% 10NF	4822 122 31414
C 7103	-20+50% 10NF	4822 122 31414
C 7104	-10+50% 220UF	4822 124 20681
C 7106	-10+50% 220UF	4822 124 20681

16.4.2 Resistors

POSNR	DESCRIPTION	ORDERING CODE
R 1001	MR25 1% 1K	4822 116 51235
R 1002	MR25 1% 42E2	5322 116 51052
R 1003	MR25 1% 100E	5322 116 53126
R 1004	0.25% 10K1	5322 116 53404
R 1006	MR25 1% 100E	5322 116 53126
R 1007	0.25% 900K	5322 116 53414
R 1008	MR25 1% 10K	4822 116 51253
R 1009	MR25 1% 21K5	5322 116 50451
R 1011	0.25% 111K	5322 116 53409
R 1012	0.25% 900K	5322 116 53414
R 1013	0.25% 1M	5322 116 53398
R 1014	MR25 1% 10K	4822 116 51253
R 1016	MR25 1% 21K5	5322 116 50451
R 1017	MR25 1% 100K	4822 116 51268
R 1018	MR25 1% 10E	5322 116 50452
R 1019	0.25% 990K	5322 116 53415
R 1022	MR25 1% 68E1	5322 116 54455
R 1023	VR25 10% 22M	5322 116 51785
R 1024	MR25 1% 10E	5322 116 50452
R 1026	MR25 1% 51E1	5322 116 53213
R 1027	VR25 10% 22M	5322 116 51785
R 1028	MR25 1% 10E	5322 116 50452
R 1029	0.25% 1M	5322 116 53398
R 1031	VR25 10% 22M	5322 116 51785
R 1032	MR25 1% 10E	5322 116 50452
R 1033	VR25 10% 22M	5322 116 51785
R 1034	MR25 1% 1M	5322 116 55535
R 1035	MR25 1% 100E	5322 116 55549
R 1036	0.3W 25% 22K	5322 105 20035
R 1037	MR25 1% 100K	4822 116 51268
R 1038	VR25 10% 22M	5322 116 51785
R 1039	MR25 1% 1K96	5322 116 54571
R 1040	MR25 1% 68E1	5322 116 54455
R 1041	MR25 1% 1K96	5322 116 54571
R 1043	MR25 1% 100E	5322 116 55549
R 1044	MR25 1% 825E	5322 116 54541
R 1045	MR25 1% 100E	5322 116 55549
R 1046	MR25 1% 750E	4822 116 51234
R 1047	MR25 1% 1K62	5322 116 55359
R 1048	MR25 1% 5K11	5322 116 54595
R 1049	MR25 1% 1K47	5322 116 50635
R 1050	MR25 1% 1K33	5322 116 55422
R 1051	MR25 1% 1K	4822 116 51235
R 1052	MR25 1% 1K	4822 116 51235
R 1053	0.25% 250E	5322 116 53406
R 1054	MR25 1% 100E	5322 116 55549
R 1056	0.25% 375E	5322 116 53407
R 1057	0.25% 150E	5322 116 53399
R 1058	0.25% 150E	5322 116 53399
R 1061	MR25 1% 237E	5322 116 50679
R 1062	MR25 1% 133E	5322 116 54482
R 1063	MR25 1% 26K1	5322 116 53261
R 1064	0.3W 25% 10K	4822 105 10455
R 1066	MR25 1% 16K2	5322 116 55361
R 1067	MR25 1% 12K1	4822 116 52957
R 1068	MR25 1% 133E	5322 116 54482
R 1069	0.3W 25% 100E	5322 105 20029
R 1071	MR25 1% 26K1	5322 116 53261
R 1072	0.3W 25% 10K	4822 105 10455
R 1073	MR25 1% 4K64	5322 116 53212

POSNR	DESCRIPTION	ORDERING CODE
R 1074	MR25 1% 5K62	5322 116 53495
R 1076	0.3W 25% 100E	5322 105 20029
R 1077	MR25 1% 10E	5322 116 50452
R 1078	MR25 1% 12K1	5322 116 50572
R 1079	MR25 1% 1K62	5322 116 55359
R 1081	MR25 1% 511E	4822 116 51282
R 1082	MR25 1% 100K	4822 116 51268
R 1083	MR25 1% 11K	5322 116 54623
R 1084	MR25 1% 82K5	5322 116 55374
R 1086	MR25 1% 12K1	5322 116 50572
R 1087	MR25 1% 1M	5322 116 55535
R 1088	MR25 1% 100E	5322 116 55549
R 1089	MR25 1% 464E	5322 116 50536
R 1091	0.3W 25% 100E	5322 105 20029
R 1092	MR25 1% 10E	5322 116 50452
R 1093	MR25 1% 464E	5322 116 50536
R 1094	MR25 1% 100E	5322 116 55549
R 1096	MR25 1% 100E	5322 116 55549
R 1097	MR25 1% 100E	5322 116 55549
R 1098	MR25 1% 1K21	5322 116 54557
R 1099	MR25 1% 1K21	5322 116 54557
R 1101	MR25 1% 1K	4822 116 51235
R 1102	MR25 1% 42E2	5322 116 51052
R 1103	MR25 1% 100E	5322 116 53126
R 1104	0.25% 10K1	5322 116 53404
R 1106	MR25 1% 100E	5322 116 53126
R 1107	0.25% 900K	5322 116 53414
R 1108	MR25 1% 10K	4822 116 51253
R 1109	MR25 1% 21K5	5322 116 50451
R 1111	0.25% 111K	5322 116 53409
R 1112	0.25% 900K	5322 116 53414
R 1113	0.25% 1M	5322 116 53398
R 1114	MR25 1% 10K	4822 116 51253
R 1116	MR25 1% 21K5	5322 116 50451
R 1117	MR25 1% 100K	4822 116 51268
R 1118	MR25 1% 10E	5322 116 50452
R 1119	0.25% 990K	5322 116 53415
R 1122	MR25 1% 68E1	5322 116 54455
R 1123	VR25 10% 22M	5322 116 51785
R 1124	MR25 1% 10E	5322 116 50452
R 1126	MR25 1% 51E1	5322 116 53213
R 1127	VR25 10% 22M	5322 116 51785
R 1128	MR25 1% 10E	5322 116 50452
R 1129	0.25% 1M	5322 116 53398
R 1131	VR25 10% 22M	5322 116 51785
R 1132	MR25 1% 10E	5322 116 50452
R 1133	VR25 10% 22M	5322 116 51785
R 1134	MR25 1% 1M	5322 116 55535
R 1135	MR25 1% 100E	5322 116 55549
R 1136	0.3W 25% 22K	5322 105 20035
R 1137	MR25 1% 100K	4822 116 51268
R 1138	VR25 10% 22M	5322 116 51785
R 1139	MR25 1% 1K96	5322 116 54571
R 1140	MR25 1% 68E1	5322 116 54455
R 1141	MR25 1% 1K96	5322 116 54571
R 1143	MR25 1% 100E	5322 116 55549
R 1144	MR25 1% 825E	5322 116 54541
R 1145	MR25 1% 100E	5322 116 55549
R 1146	MR25 1% 750E	4822 116 51234
R 1147	MR25 1% 1K62	5322 116 55359

POSNR	DESCRIPTION	ORDERING CODE
R 1148	MR25 1% 5K11	5322 116 54595
R 1149	MR25 1% 1K47	5322 116 50635
R 1150	MR25 1% 1K33	5322 116 55422
R 1151	MR25 1% 1K	4822 116 51235
R 1152	MR25 1% 1K	4822 116 51235
R 1153	0.25% 250E	5322 116 53406
R 1154	MR25 1% 100E	5322 116 55549
R 1156	0.25% 375E	5322 116 53407
R 1157	0.25% 150E	5322 116 53399
R 1158	0.25% 150E	5322 116 53399
R 1161	MR25 1% 237E	5322 116 50679
R 1161	MR25 1% 12K1	4822 116 52957
R 1162	MR25 1% 133E	5322 116 54482
R 1163	MR25 1% 31K6	5322 116 54657
R 1163	MR25 1% 26K1	5322 116 53261
R 1164	0.3W 25% 10K	4822 105 10455
R 1166	MR25 1% 16K2	5322 116 55361
R 1168	MR25 1% 133E	5322 116 54482
R 1169	0.3W 25% 100E	5322 105 20029
R 1171	MR25 1% 26K1	5322 116 53261
R 1172	0.3W 25% 10K	4822 105 10455
R 1173	MR25 1% 4K64	5322 116 53212
R 1174	MR25 1% R62	5322 116 53495
R 1176	0.3W 25% 100E	5322 105 20029
R 1177	MR25 1% 10E	5322 116 50452
R 1178	MR25 1% 12K1	5322 116 50572
R 1179	MR25 1% 1K62	5322 116 55359
R 1181	MR25 1% 511E	4822 116 51282
R 1182	MR25 1% 100K	4822 116 51268
R 1183	MR25 1% 11K	5322 116 54623
R 1184	MR25 1% 82K5	5322 116 55374
R 1186	MR25 1% 12K1	5322 116 50572
R 1187	MR25 1% 1M	5322 116 55535
R 1188	MR25 1% 100E	5322 116 55549
R 1189	MR25 1% 464E	5322 116 50536
R 1191	0.3W 25% 100E	5322 105 20029
R 1192	MR25 1% 10E	5322 116 50452
R 1193	MR25 1% 464E	5322 116 50536
R 1194	MR25 1% 100E	5322 116 55549
R 1196	MR25 1% 100E	5322 116 55549
R 1197	MR25 1% 100E	5322 116 55549
R 1198	MR25 1% 1K21	5322 116 54557
R 1199	MR25 1% 1K21	5322 116 54557
R 1201	MR25 1% 1K	4822 116 51235
R 1202	MR25 1% 31E6	5322 116 54034
R 1203	MR30 1% 1M	4822 116 51279
R 1204	VR25 10% 22M	5322 116 51785
R 1206	MR25 1% 1K96	5322 116 54571
R 1207	MR25 1% 100E	5322 116 55549
R 1208	MR25 1% 825E	5322 116 54541
R 1209	MR25 1% 1M	5322 116 55535
R 1211	MR25 1% 100E	5322 116 55549
R 1213	MR25 1% 1M	5322 116 55535
R 1217	0.3W 25% 22K	5322 105 20035
R 1218	MR25 1% 100K	4822 116 51268
R 1219	MR25 1% 1K47	5322 116 50635
R 1220	MR25 1% 1E	4822 116 52167
R 1221	MR25 1% 681E	4822 116 53123
R 1222	MR25 1% 2K87	5322 116 53513
R 1223	MR25 1% 1K33	5322 116 55422
R 1224	MR25 1% 1K	4822 116 51235
R 1226	MR25 1% 2K87	5322 116 55279
R 1227	MR25 1% 1K33	5322 116 53512
R 1228	MR25 1% 237E	5322 116 50679
R 1229	MR25 1% 750E	4822 116 51234

POSNR	DESCRIPTION	ORDERING CODE
R 1231	MR25 1% 750E	4822 116 51234
R 1232	MR25 1% 1E	4822 116 52167
R 1233	MR25 1% 348E	5322 116 54515
R 1234	MR25 1% 237E	5322 116 50679
R 1236	MR25 1% 162E	5322 116 50417
R 1237	MR25 1% 2K61	5322 116 50671
R 1238	MR25 1% 100E	5322 116 55549
R 1239	MR25 1% 7K5	5322 116 54608
R 1401	MR25 1% 5E11	4822 116 52999
R 1402	MR25 1% 5E11	4822 116 52999
R 1403	MR25 1% 5E11	4822 116 52999
R 1404	MR25 1% 5E11	4822 116 52999
R 1421	MR25 1% 5E11	4822 116 52999
R 1422	MR25 1% 5E11	4822 116 52999
R 1423	MR25 1% 5E11	4822 116 52999
R 1424	MR25 1% 5E11	4822 116 52999
R 1441	MR25 1% 100E	5322 116 55549
R 1442	MR25 1% 5E11	4822 116 52999
R 1443	MR25 1% 5E11	4822 116 52999
R 2001	MR25 1% 10E	5322 116 50452
R 2002	MR25 1% 10E	5322 116 50452
R 2003	MR25 1% 51E1	5322 116 53213
R 2004	MR25 1% 51E1	5322 116 53213
R 2101	MR25 1% 10E	5322 116 50452
R 2102	MR25 1% 10E	5322 116 50452
R 2103	MR25 1% 51E1	5322 116 53213
R 2104	MR25 1% 51E1	5322 116 53213
R 2201	MR25 1% 100K	4822 116 51268
R 2202	MR25 1% 10K	4822 116 51253
R 2203	MR25 1% 316K	5322 116 55268
R 2204	MR25 1% 10K	4822 116 51253
R 2205	MR25 1% 2K15	5322 116 50767
R 2206	MR25 1% 100K	4822 116 51268
R 2207	MR25 1% 10K	4822 116 51253
R 2208	MR25 1% 316K	5322 116 55268
R 2209	MR25 1% 10K	4822 116 51253
R 2210	MR25 1% 2K15	5322 116 50767
R 2211	MR25 1% 5K62	4822 116 51281
R 2212	0.3W 25% 22K	5322 105 20035
R 2213	MR25 1% 237K	5322 116 54732
R 2214	MR25 1% 10K	4822 116 51253
R 2215	MR25 1% 2K15	5322 116 50767
R 2216	MR25 1% 5K62	4822 116 51281
R 2217	MR25 1% 100K	4822 116 51268
R 2218	MR25 1% 4K64	5322 116 53212
R 2219	MR25 1% 316K	5322 116 55268
R 2221	MR25 1% 19K6	5322 116 54641
R 2230	MR25 1% 316E	5322 116 53514
R 2231	MR25 1% 261E	5322 116 54502
R 2232	MR25 1% 383E	5322 116 55368
R 2234	MR25 1% 4K64	5322 116 53515
R 2236	MR25 1% 681E	4822 116 51233
R 2237	MR25 1% 422E	5322 116 50459
R 2239	MR25 1% 348E	5322 116 54515
R 2241	MR25 1% 1K	4822 116 51235
R 2242	MR25 1% 422E	5322 116 50459
R 2243	MR25 1% 681E	4822 116 51233
R 2244	MR25 1% 4K64	5322 116 53515
R 2246	MR25 1% 261E	5322 116 54502
R 2247	MR25 1% 383E	5322 116 55368
R 2251	MR25 1% 75E	5322 116 54459
R 2252	MR25 1% 750E	4822 116 51234
R 2253	MR25 1% 750E	4822 116 51234
R 2254	MR25 1% 75E	5322 116 54459
R 2255	MR25 1% 287E	5322 116 54506

POSNR	DESCRIPTION	ORDERING CODE
R 2301	MR25 1% 19K6	5322 116 54641
R 2302	MR25 1% 19K6	5322 116 54641
R 2303	MR25 1% 5K62	4822 116 51281
R 2304	MR25 1% 5K62	4822 116 51281
R 2311	MR25 1% 2K87	5322 116 55279
R 2317	MR25 1% 681E	4822 116 51233
R 2318	MR25 1% 681E	4822 116 51233
R 2319	MR25 1% 5E11	4822 116 52999
R 2324	MR25 1% 5K62	4822 116 51281
R 2325	MR25 1% 5K62	4822 116 51281
R 2326	MR25 1% 2K87	5322 116 55279
R 2327	MR25 1% 3K83	5322 116 54589
R 2328	MR25 1% 2K87	5322 116 55279
R 2329	MR25 1% 825E	5322 116 54541
R 2335	MR25 1% 10K	4822 116 51253
R 2336	MR25 1% 31E6	5322 116 54034
R 2337	MR25 1% 133E	5322 116 54482
R 2338	MR25 1% 2K61	5322 116 50671
R 2339	MR25 1% 237E	5322 116 50679
R 2341	MR25 1% 31E6	5322 116 54034
R 2342	MR25 1% 133E	5322 116 54482
R 2344	MR25 1% 511E	4822 116 51282
R 2345	MR25 1% 100E	5322 116 55549
R 2348	MR25 1% 8K25	5322 116 51498
R 2350	MR25 1% 4K22	5322 116 50729
R 2351	MR25 1% 562E	4822 116 51231
R 2352	MR25 1% 825E	5322 116 54541
R 2357	MR25 1% 681E	4822 116 51233
R 2358	MR25 1% 511E	4822 116 51282
R 2360	MR25 1% 100E	5322 116 55549
R 2361	MR25 1% 4K22	5322 116 50729
R 2365	MR25 1% 23K7	5322 116 54646
R 2366	MR25 1% 10K	4822 116 51253
R 2367	MR25 1% 16K2	5322 116 55361
R 2369	MR25 1% 82K5	5322 116 55374
R 2371	MR25 1% 422E	5322 116 50459
R 2372	MR25 1% 511E	4822 116 51282
R 2373	MR25 1% 90K9	5322 116 54694
R 2374	MR25 1% 511E	4822 116 51282
R 2375	MR25 1% 23K7	5322 116 54646
R 2376	VR25 10% 22M	5322 116 51785
R 2377	VR25 10% 22M	5322 116 51785
R 2378	VR25 10% 22M	5322 116 51785
R 2379	VR25 10% 22M	5322 116 51785
R 2380	MR25 1% 750E	4822 116 51234
R 2381	MR25 1% 2K87	5322 116 55279
R 2382	MR25 1% 2K87	5322 116 55279
R 2383	MR25 1% 1K	4822 116 51235
R 2384	MR25 1% 750E	4822 116 51234
R 2386	MR25 1% 1K	4822 116 51235
R 2387	MR25 1% 750E	4822 116 51234
R 2388	MR25 1% 1K	4822 116 51235
R 2389	MR25 1% 1K	4822 116 51235
R 2391	MR25 1% 42E2	5322 116 51052
R 2393	MR25 1% 3K48	5322 116 55367
R 2394	MR25 1% 100E	5322 116 55549
R 2395	0.3W 25% 220E	5322 105 20031
R 2396	MR25 1% 681E	4822 116 51233
R 2396	MR25 1% 3K48	5322 116 55367
R 2397	MR25 1% 42E2	5322 116 51052
R 2403	MR25 1% 42E2	5322 116 51052
R 2404	MR25 1% 619E	4822 116 51232
R 2406	MR25 1% 1K62	5322 116 55359
R 2407	0.3W 25% 220E	5322 105 20031
R 2408	MR25 1% 1K33	5322 116 55422

POSNR	DESCRIPTION	ORDERING CODE
R 2409	MR25 1% 1K62	5322 116 55359
R 2410	0.3W 25% 1K	5322 105 20032
R 2411	MR25 1% 42E2	5322 116 51052
R 2412	MR25 1% 619E	4822 116 51232
R 2416	MR25 1% 1K	4822 116 51235
R 2418	MR25 1% 5K62	4822 116 51281
R 2419	MR25 1% 1K1	4822 116 51236
R 2420	MR25 1% 237E	5322 116 50679
R 2421	MR25 1% 5K62	4822 116 51281
R 2422	MR25 1% 1K	4822 116 51235
R 2430	MR25 1% 100K	4822 116 51268
R 2431	MR25 1% 100K	4822 116 51268
R 2432	MR25 1% 100K	4822 116 51268
R 2433	MR25 1% 100K	4822 116 51268
R 2434	MR25 1% 100K	4822 116 51268
R 2435	MR25 1% 10K	4822 116 51253
R 2501	MR25 1% 19K6	5322 116 54641
R 2502	MR25 1% 19K6	5322 116 54641
R 2503	MR25 1% 5K62	4822 116 51281
R 2504	MR25 1% 2K87	5322 116 55279
R 2522	MR25 1% 5K62	4822 116 51281
R 2523	MR25 1% 5K62	4822 116 51281
R 2527	MR25 1% 100K	4822 116 51268
R 2528	MR25 1% 11K	4822 116 52907
R 2529	MR25 1% 316K	5322 116 55268
R 2541	MR25 1% 162E	5322 116 50417
R 2542	MR25 1% 1K62	5322 116 55359
R 2543	MR25 1% 681E	4822 116 51233
R 2544	MR25 1% 121E	5322 116 54426
R 2547	MR25 1% 511E	4822 116 51282
R 2548	MR25 1% 1K21	5322 116 54557
R 2549	MR25 1% 1K33	5322 116 55422
R 2551	MR25 1% 162E	5322 116 50417
R 2552	MR25 1% 681E	4822 116 51233
R 2553	MR25 1% 1K62	5322 116 55359
R 2554	MR25 1% 42E2	5322 116 51052
R 2555	MR25 1% 8K25	5322 116 51498
R 2556	MR25 1% 42E2	5322 116 51052
R 2557	MR25 1% 4K22	5322 116 50729
R 2558	MR25 1% 4K22	5322 116 50729
R 2559	MR25 1% 100E	5322 116 55549
R 2601	MR25 1% 3K16	5322 116 50579
R 2602	MR25 1% 5E11	4822 116 52999
R 2603	MR25 1% 5K11	5322 116 54595
R 2604	MR25 1% 5K11	5322 116 54595
R 2605	MR25 1% 12K1	5322 116 50572
R 2606	MR25 1% 1E	4822 116 52167
R 2607	MR25 1% 3K48	5322 116 55367
R 2610	MR25 1% 10K	4822 116 51253
R 2611	MR25 1% 1K96	5322 116 54571
R 2621	MR25 1% 383E	5322 116 55368
R 2622	MR25 1% 681E	4822 116 51233
R 2623	MR25 1% 1K1	4822 116 51236
R 2624	MR25 1% 3K48	5322 116 55367
R 2625	MR25 1% 681E	4822 116 51233
R 2626	MR25 1% 6K81	4822 116 51252
R 2627	MR25 1% 287E	5322 116 54506
R 2628	MR25 1% 2K15	5322 116 50767
R 2629	MR25 1% 10K	4822 116 51253
R 2631	MR25 1% 10K	4822 116 51253
R 2632	MR25 1% 383E	5322 116 55368
R 2635	MR25 1% 10K	4822 116 51253
R 2701	MR25 1% 1E	4822 116 52167
R 2702	MR25 1% 11E	5322 116 54059
R 2704	MR25 1% 5E11	4822 116 52999

POSNR	DESCRIPTION	ORDERING CODE
R 2712	MR25 1% 5E11	4822 116 52999
R 2713	MR25 1% 5E11	4822 116 52999
R 2714	MR25 1% 5E11	4822 116 52999
R 2721	MR25 1% 5E11	4822 116 52999
R 2722	MR25 1% 5E11	4822 116 52999
R 2723	MR25 1% 5E11	4822 116 52999
R 2724	MR25 1% 5E11	4822 116 52999
R 2731	MR25 1% 5E11	4822 116 52999
R 2732	MR25 1% 5E11	4822 116 52999
R 2733	MR25 1% 5E11	4822 116 52999
R 2740	MR25 1% 5E11	4822 116 52999
R 2741	MR25 1% 31E6	5322 116 54034
R 2742	MR25 1% 5E11	4822 116 52999
R 3001	MR25 1% 147E	5322 116 50766
R 3002	MR25 1% 464E	5322 116 50536
R 3003	MR25 1% 1K47	5322 116 50635
R 3004	MR25 1% 422E	5322 116 50459
R 3006	MR25 1% 2K37	5322 116 54576
R 3007	0.3W 25% 2K2	5322 105 20033
R 3008	MR25 1% 121E	5322 116 54426
R 3009	MR25 1% 3K83	5322 116 54589
R 3011	MR25 1% 121E	5322 116 54426
R 3012	MR25 1% 464E	5322 116 50536
R 3013	0.3W 25% 10K	4822 105 10455
R 3014	MR25 1% 1K21	5322 116 54557
R 3015	MR25 1% 316E	5322 116 54511
R 3016	MR25 1% 2K37	5322 116 54576
R 3017	0.3W 25% 10K	4822 105 10455
R 3018	MR25 1% 8K25	5322 116 53267
R 3020	MR25 1% 10E	4822 116 52891
R 3021	MR25 1% 464E	5322 116 50536
R 3022	MR25 1% 750E	4822 116 51234
R 3023	MR25 1% 348E	5322 116 54515
R 3024	MR25 1% 750E	4822 116 51234
R 3025	MR25 1% 10E	4822 116 52891
R 3026	MR25 1% 464E	5322 116 50536
R 3027	MR25 1% 42E2	5322 116 53515
R 3028	MR25 1% 42E2	5322 116 53515
R 3029	MR25 1% 681E	4822 116 51233
R 3031	MR25 1% 422E	5322 116 50459
R 3032	MR25 1% 28E7	5322 116 54068
R 3033	MR25 1% 100E	5322 116 55549
R 3034	MR25 1% 162E	5322 116 53523
R 3036	0.3W 25% 100E	5322 105 20029
R 3037	MR25 1% 100E	5322 116 55549
R 3038	0.3W 25% 100E	5322 105 20028
R 3039	MR25 1% 42E2	5322 116 51052
R 3041	MR25 1% 316E	5322 116 54511
R 3042	MR52 1% 1K33	5322 116 52164
R 3043	MR52 1% 1K33	5322 116 52164
R 3044	MR52 1% 1K33	5322 116 52164
R 3046	MR52 1% 1K33	5322 116 52164
R 3049	MR25 1% 100K	4822 116 51268
R 3051	MR25 1% 100K	4822 116 51268
R 3100	MR25 1% 42E2	5322 116 51052
R 3101	MR25 1% 5K62	4822 116 51281
R 3102	MR25 1% 681E	4822 116 53123
R 3103	MR25 1% 1K21	5322 116 54557
R 3104	MR25 1% 6K81	4822 116 51252
R 3106	MR25 1% 42E2	5322 116 51052

POSNR	DESCRIPTION	ORDERING CODE
R 3107	MR25 1% 2K87	5322 116 55279
R 3108	MR25 1% 909E	5322 116 55278
R 3109	MR25 1% 6K19	5322 116 55426
R 3110	MR25 1% 42E2	5322 116 51052
R 3111	MR25 1% 42E2	5322 116 51052
R 3112	MR25 1% 7K5	5322 116 54608
R 3113	MR25 1% 1K21	5322 116 54557
R 3114	MR25 1% 5K62	4822 116 51281
R 3115	MR25 1% 42E2	5322 116 51052
R 3116	MR25 1% 681E	4822 116 53123
R 3117	MR25 1% 4K64	5322 116 50484
R 3118	0.3W 25% 1K	5322 105 20032
R 3119	MR25 1% 4K64	5322 116 50484
R 3120	MR25 1% 42E2	5322 116 51052
R 3121	MR25 1% 46K4	5322 116 50557
R 3122	MR25 1% 6K81	4822 116 51252
R 3124	MR25 1% 619E	4822 116 51232
R 3125	MR25 1% 42E2	5322 116 51052
R 3126	MR25 1% 14K7	5322 116 54632
R 3127	MR25 1% 1K47	5322 116 50635
R 3128	MR25 1% 825E	5322 116 54541
R 3129	MR25 1% 1K21	5322 116 54557
R 3130	MR25 1% 42E2	5322 116 51052
R 3131	MR25 1% 1K47	5322 116 50635
R 3132	MR25 1% 825E	5322 116 54541
R 3133	MR25 1% 6K19	5322 116 55426
R 3134	MR25 1% 14K7	5322 116 54632
R 3136	MR25 1% 1K	4822 116 51235
R 3137	MR25 1% 46K4	5322 116 50557
R 3138	MR25 1% 6K81	4822 116 51252
R 3139	MR25 1% 619E	4822 116 51232
R 3141	MR25 1% 316E	5322 116 54511
R 3142	MR25 1% 316E	5322 116 54511
R 3143	MR25 1% 10E	5322 116 50452
R 3144	MR25 1% 10E	5322 116 50452
R 3146	MR25 1% 316E	5322 116 54511
R 3147	NTC 3K3	5322 116 30234
R 3148	MR25 1% 5K62	5322 116 53495
R 3149	MR25 1% 75K	5322 116 53266
R 3200	MR25 1% 8K25	5322 116 51498
R 3201	MR25 1% 1K1	4822 116 51236
R 3202	MR25 1% 100E	5322 116 55549
R 3203	MR25 1% 16K2	5322 116 55361
R 3204	MR25 1% 562E	4822 116 51231
R 3205	MR25 1% 4K64	5322 116 50484
R 3206	MR25 1% 4K64	5322 116 50484
R 3207	MR25 1% 82K5	5322 116 55374
R 3208	MR25 1% 7K5	5322 116 54608
R 3209	MR25 1% 1K	4822 116 51235
R 3210	MR25 1% 42E2	5322 116 51052
R 3211	MR25 1% 10K	4822 116 51253
R 3212	MR25 1% 1K47	5322 116 50635
R 3213	MR25 1% 23K7	5322 116 54646
R 3214	MR25 1% 51K1	5322 116 50672
R 3215	MR25 1% 4K64	5322 116 50484
R 3216	MR25 1% 178K	5322 116 54721
R 3217	MR25 1% 511E	4822 116 51282
R 3218	MR25 1% 51K1	5322 116 50672
R 3219	MR25 1% 1M	5322 116 55535
R 3221	MR25 1% 100E	5322 116 55549
R 3222	MR25 1% 100K	4822 116 51268
R 3223	MR25 1% 51K1	5322 116 50672
R 3224	MR25 1% 2K37	5322 116 54576
R 3226	MR25 1% 100E	5322 116 55549
R 3250	MR25 1% 2K37	5322 116 54576

POSNR	DESCRIPTION	ORDERING CODE
R 3251	MR25 1% 1M	5322 116 55535
R 3253	MR25 1% 75K	4822 116 51267
R 3254	MR25 1% 1K	4822 116 51235
R 3256	MR25 1% 178K	5322 116 54721
R 3257	MR25 1% 825K	5322 116 51398
R 3258	VR25 5% 3M3	4822 110 72201
R 3259	VR25 5% 3M3	4822 110 72201
R 3261	VR25 5% 3M3	4822 110 72201
R 3262	VR25 5% 7M5	5322 116 60131
R 3263	VR25 5% 3M3	4822 110 72201
R 3267	MR25 1% 10K	4822 116 51253
R 3268	MR25 1% 681K	5322 116 55284
R 3269	MR25 1% 16K2	5322 116 55361
R 3301	MR25 1% 10E	5322 116 50452
R 3302	MR25 1% 1E	4822 116 52167
R 3303	MR25 1% 5E11	4822 116 52999
R 3304	MR25 1% 5E11	4822 116 52999
R 3306	MR25 1% 2K87	5322 116 55279
R 3308	MR25 1% 10E	5322 116 50452
R 3309	MR25 1% 5E11	4822 116 52999
R 3311	MR25 1% 5E11	4822 116 52999
R 3312	MR25 1% 5E11	4822 116 52999
R 3313	MR25 1% 10E	5322 116 50452
R 4000	MR25 1% 100E	5322 116 55549
R 4001	MR25 1% 619E	4822 116 51232
R 4002	MR25 1% 511E	4822 116 51282
R 4003	MR25 1% 511E	4822 116 51282
R 4004	MR25 1% 6K19	5322 116 55426
R 4005	MR25 1% 100E	5322 116 55549
R 4006	MR25 1% 100E	5322 116 55549
R 4007	MR25 1% 6K19	5322 116 55426
R 4008	MR25 1% 100E	5322 116 55549
R 4009	0.3W 25% 1K	5322 105 20032
R 4010	MR25 1% 511E	4822 116 51282
R 4011	MR25 1% 5K11	5322 116 54595
R 4012	MR25 1% 1K78	5322 116 50515
R 4013	MR25 1% 1M	5322 116 55535
R 4014	MR25 1% 5K11	5322 116 54595
R 4015	MR25 1% 1K	4822 116 51235
R 4016	MR25 1% 5K11	5322 116 54595
R 4017	MR25 1% 2K87	5322 116 55279
R 4018	MR25 1% 5K11	5322 116 54595
R 4019	MR25 1% 681K	5322 116 55284
R 4020	MR25 1% 1K62	5322 116 55359
R 4021	MR25 1% 10K	4822 116 51253
R 4022	MR25 1% 4K22	5322 116 50729
R 4023	MR25 1% 12K1	5322 116 50572
R 4025	MR25 1% 1K62	5322 116 55359
R 4026	MR25 1% 5K11	5322 116 54595
R 4030	MR25 1% 100E	5322 116 55549
R 4031	MR25 1% 619E	4822 116 51232
R 4032	MR25 1% 511E	4822 116 51282
R 4033	MR25 1% 511E	4822 116 51282
R 4034	MR25 1% 2K15	5322 116 50767
R 4035	MR25 1% 100E	5322 116 55549
R 4036	MR25 1% 100E	5322 116 55549
R 4037	MR25 1% 2K15	5322 116 50767
R 4038	MR25 1% 100E	5322 116 55549
R 4039	0.3W 25% 1K	5322 105 20032
R 4040	MR25 1% 511E	4822 116 51282
R 4041	MR25 1% 5K11	5322 116 54595
R 4042	MR25 1% 1K78	5322 116 50515
R 4043	MR25 1% 51K1	5322 116 50672
R 4044	MR25 1% 51K1	5322 116 50672
R 4045	MR25 1% 681K	5322 116 55284

POSNR	DESCRIPTION	ORDERING CODE
R 4046	MR25 1% 10K	4822 116 51253
R 4047	MR25 1% 4K22	5322 116 50729
R 4048	MR25 1% 2K61	5322 116 50671
R 4051	MR25 1% 10K	4822 116 51253
R 4052	MR25 1% 10K	4822 116 51253
R 4053	MR25 1% 10E	5322 116 50452
R 4054	MR25 1% 1K	4822 116 51235
R 4056	MR25 1% 100E	5322 116 55549
R 4101	MR25 1% 110K	5322 116 54701
R 4102	MR25 1% 5K11	5322 116 54595
R 4103	MR25 1% 15K4	5322 116 55459
R 4104	MR25 1% 46K4	5322 116 50557
R 4106	MR25 1% 511E	4822 116 51282
R 4107	0.3W 25% 10K	4822 105 10455
R 4108	0.3W 25% 10K	4822 105 10455
R 4109	MR25 1% 5K11	5322 116 53494
R 4111	MR25 1% 12K1	4822 116 52957
R 4118	0.25% 50E	5322 116 53405
R 4119	0.25% 50E	5322 116 53405
R 4120	MR25 1% 1K	4822 116 51235
R 4121	0.25% 150E	5322 116 53399
R 4122	0.25% 250E	5322 116 53406
R 4123	0.25% 500E	5322 116 53408
R 4124	0.25% 1K5	5322 116 53401
R 4125	MR25 1% 100E	5322 116 55549
R 4126	MR25 1% 9K09	4822 116 51284
R 4127	MR25 1% 1K62	5322 116 55359
R 4128	MR25 1% 10K	4822 116 51253
R 4129	MR25 1% 1M	5322 116 55535
R 4130	MR25 1% 1K	4822 116 51235
R 4131	MR25 1% 5K11	5322 116 54595
R 4132	MR25 1% 5K11	5322 116 54595
R 4133	MR25 1% 3K48	5322 116 55367
R 4134	MR25 1% 10K	4822 116 51253
R 4135	MR25 1% 1K	4822 116 51235
R 4136	MR25 1% 10K	4822 116 51253
R 4137	MR25 1% 14K7	5322 116 54632
R 4138	MR25 1% 5E11	4822 116 52999
R 4139	MR25 1% 10K	4822 116 51253
R 4140	MR25 1% 10K	4822 116 51253
R 4141	MR25 1% 14K7	5322 116 54632
R 4142	MR25 1% 100E	5322 116 55549
R 4143	0.1% 20K	5322 116 52697
R 4144	0.1% 202E	5322 116 53413
R 4145	MR25 1% 2K37	5322 116 54576
R 4146	MR25 1% 51K1	5322 116 50672
R 4147	MR25 1% 511E	4822 116 51282
R 4148	MR25 1% 21K5	5322 116 50451
R 4149	MR25 1% 31E6	5322 116 54034
R 4150	MR25 1% 9E09	5322 116 50863
R 4151	MR25 1% 2K61	5322 116 50671
R 4152	MR25 1% 162E	5322 116 50417
R 4153	MR25 1% 1K1	4822 116 51236
R 4154	MR25 1% 1K78	5322 116 50515
R 4155	MR25 1% 2K15	5322 116 50767
R 4156	MR25 1% 1M	5322 116 55535
R 4158	MR25 1% 1M	5322 116 55535
R 4159	MR25 1% 2K15	5322 116 50767
R 4160	MR25 1% 100E	5322 116 55549
R 4161	MR25 1% 10K	4822 116 51253
R 4162	MR25 1% 100E	5322 116 55549
R 4207	0.3W 25% 10K	4822 105 10455
R 4208	0.3W 25% 10K	4822 105 10455
R 4209	MR25 1% 5K11	5322 116 53494
R 4211	MR25 1% 12K1	4822 116 52957

POSNR	DESCRIPTION	ORDERING CODE
R 4218	0.25% 50E	5322 116 53405
R 4219	0.25% 50E	5322 116 53405
R 4221	0.25% 150E	5322 116 53399
R 4222	0.25% 250E	5322 116 53406
R 4223	0.25% 500E	5322 116 53408
R 4224	0.25% 1K5	5322 116 53401
R 4239	MR25 1% 10K	4822 116 51253
R 4240	MR25 1% 10K	4822 116 51253
R 4242	MR25 1% 100E	5322 116 55549
R 4243	0.1% 20K	5322 116 52697
R 4244	0.1% 202E	5322 116 53413
R 4245	MR25 1% 2K37	5322 116 54576
R 4246	MR25 1% 51K1	5322 116 50672
R 4247	MR25 1% 511E	4822 116 51282
R 4248	MR25 1% 21K5	5322 116 50451
R 4249	MR25 1% 31E6	5322 116 54034
R 4250	MR25 1% 9E09	5322 116 50863
R 4251	MR25 1% 2K61	5322 116 50671
R 4252	MR25 1% 162E	5322 116 50417
R 4253	MR25 1% 5K11	5322 116 54595
R 4254	MR25 1% 6K81	4822 116 51252
R 4258	MR25 1% 1M	5322 116 55535
R 4259	MR25 1% 2K15	5322 116 50767
R 4260	MR25 1% 100E	5322 116 55549
R 4261	MR25 1% 10K	4822 116 51253
R 4262	MR25 1% 100E	5322 116 55549
R 4301	MR25 1% 51K1	5322 116 50672
R 4302	MR25 1% 51K1	5322 116 50672
R 4303	MR25 1% 3K16	5322 116 50579
R 4304	MR25 1% 3K16	5322 116 50579
R 4306	MR25 1% 13K3	5322 116 55276
R 4307	MR25 1% 10K	4822 116 51253
R 4309	MR25 1% 1K	4822 116 51235
R 4310	MR25 1% 100E	5322 116 55549
R 4311	MR25 1% 10K	4822 116 51253
R 4312	MR25 1% 5K11	5322 116 54595
R 4313	MR25 1% 5K62	4822 116 51281
R 4314	MR25 1% 5K9	5322 116 50583
R 4331	MR25 1% 21K5	5322 116 50451
R 4332	MR25 1% 4K22	5322 116 50729
R 4334	MR25 1% 3K48	5322 116 55367
R 4401	MR25 1% 2K61	5322 116 50671
R 4402	MR25 1% 82E5	4822 116 52814
R 4403	MR25 1% 681E	4822 116 51233
R 4404	MR25 1% 2K37	5322 116 54576
R 4406	0.3W 25% 22K	5322 105 20035
R 4407	MR25 1% 237K	5322 116 54732
R 4408	0.3W 25% 22K	5322 105 20035
R 4409	MR25 1% 7K5	5322 116 54608
R 4411	MR25 1% 2K37	5322 116 54576
R 4412	MR25 1% 100E	5322 116 55549
R 4413	MR25 1% 6K81	4822 116 51252
R 4414	MR25 1% 4K64	5322 116 50484
R 4417	MR25 1% 1K	4822 116 51235
R 4419	MR25 1% 511E	4822 116 51282
R 4420	MR25 1% 1K21	5322 116 54557
R 4421	MR25 1% 10K	4822 116 51253
R 4422	MR25 1% 2K87	5322 116 55279
R 4423	MR25 1% 9K09	4822 116 51284
R 4427	MR25 1% 1K96	5322 116 54571
R 4428	MR25 1% 100E	5322 116 55549
R 4501	MR25 1% 13K3	5322 116 55276
R 4502	MR25 1% 4K22	5322 116 50729
R 4503	MR25 1% 8K25	5322 116 51498
R 4504	MR25 1% 13K3	5322 116 55276

POSNR	DESCRIPTION	ORDERING CODE
R 4505	MR25 1% 511E	4822 116 51282
R 4506	MR25 1% 2K15	5322 116 50767
R 4507	MR25 1% 750E	4822 116 51234
R 4508	MR25 1% 11K	5322 116 54623
R 4509	MR25 1% 2K15	5322 116 50767
R 4513	MR25 1% 1K47	5322 116 50635
R 4521	MR25 1% 16K2	5322 116 55361
R 4522	MR25 1% 23K7	5322 116 54646
R 4523	MR25 1% 17K8	5322 116 54637
R 4524	MR25 1% 16K2	5322 116 55361
R 4526	MR25 1% 2K37	5322 116 54576
R 4527	MR25 1% 16K2	5322 116 55361
R 4528	MR25 1% 4K64	5322 116 50484
R 4529	MR25 1% 17K8	5322 116 54637
R 4531	MR25 1% 10K	4822 116 51253
R 4532	MR25 1% 10K	4822 116 51253
R 4533	MR25 1% 3K48	5322 116 55367
R 4601	MR25 1% 2K37	5322 116 54576
R 4602	MR25 1% 26K1	5322 116 54651
R 4603	MR25 1% 23K7	5322 116 54646
R 4604	MR25 1% 100K	4822 116 51268
R 4606	MR25 1% 909E	5322 116 55278
R 4607	MR25 1% 100E	5322 116 55549
R 4608	MR25 1% 1K	4822 116 51235
R 4609	MR25 1% 42E2	5322 116 51052
R 4611	MR25 1% 10K	4822 116 51253
R 4612	MR25 1% 7K5	5322 116 54608
R 4613	MR25 1% 7K5	5322 116 54608
R 4614	MR25 1% 13K3	5322 116 55276
R 4616	0.3W 25% 1K	5322 105 20032
R 4617	MR25 1% 7K5	5322 116 54608
R 4618	MR25 1% 13K3	5322 116 55276
R 4619	MR25 1% 13K3	5322 116 55276
R 4620	MR25 1% 7K5	5322 116 54608
R 4621	MR25 1% 909E	5322 116 55278
R 4622	MR25 1% 100E	5322 116 55549
R 4625	MR25 1% 100E	5322 116 55549
R 4626	MR25 1% 100E	5322 116 55549
R 4627	MR25 1% 10K	4822 116 51253
R 4628	MR25 1% 100E	5322 116 55549
R 4629	MR25 1% 8K25	5322 116 51498
R 4631	MR25 1% 1K	4822 116 51235
R 4632	MR25 1% 100E	5322 116 55549
R 4633	MR25 1% 1K	4822 116 51235
R 4634	MR25 1% 10K	4822 116 51253
R 4636	MR25 1% 1M	5322 116 55535
R 4639	MR25 1% 383E	5322 116 55368
R 4701	MR25 1% 42E2	5322 116 51052
R 4703	MR25 1% 562E	4822 116 51231
R 4704	MR25 1% 1E	4822 116 52167
R 4705	MR25 1% 1K	4822 116 51235
R 4706	MR25 1% 100E	5322 116 55549
R 4707	MR25 1% 511E	4822 116 51282
R 4708	MR25 1% 2K87	5322 116 55279
R 4709	MR25 1% 681E	4822 116 51233
R 4711	MR25 1% 6K19	5322 116 55426
R 4712	MR25 1% 511E	4822 116 51282
R 4713	MR25 1% 1M	5322 116 55535
R 4714	MR25 1% 1M	5322 116 55535
R 4716	MR25 1% 6K81	4822 116 51252
R 4717	MR25 1% 8K25	5322 116 51498
R 4718	MR25 1% 1K	4822 116 51235
R 4719	MR25 1% 100E	5322 116 55549
R 4721	0.3W 25% 1K	5322 105 20032
R 4722	MR25 1% 46K4	5322 116 50557

POSNR	DESCRIPTION	ORDERING CODE
R 4723	MR25 1% 681K	5322 116 55284
R 4724	MR25 1% 42E2	5322 116 51052
R 4725	MR25 1% 4K22	5322 116 50729
R 4726	MR25 1% 100K	4822 116 51268
R 4727	MR25 1% 6K81	4822 116 51252
R 4728	MR25 1% 562E	4822 116 51231
R 4729	MR25 1% 1E	4822 116 52167
R 4801	MR25 1% 5E11	4822 116 52999
R 4804	MR25 1% 5E11	4822 116 52999
R 4807	MR25 1% 5E11	4822 116 52999
R 4809	MR25 1% 5E11	4822 116 52999
R 4816	MR25 1% 5E11	4822 116 52999
R 4818	MR25 1% 5E11	4822 116 52999
R 4819	MR25 1% 5E11	4822 116 52999
R 4820	MR25 1% 5E11	4822 116 52999
R 4821	MR25 1% 5E11	4822 116 52999
R 4822	MR25 1% 5E11	4822 116 52999
R 4825	MR25 1% 5E11	4822 116 52999
R 4826	MR25 1% 5E11	4822 116 52999
R 4828	MR25 1% 5E11	4822 116 52999
R 4829	MR25 1% 5E11	4822 116 52999
R 4830	MR25 1% 5E11	4822 116 52999
R 4831	MR25 1% 5E11	4822 116 52999
R 4833	MR25 1% 5E11	4822 116 52999
R 4835	MR25 1% 5E11	4822 116 52999
R 4836	MR25 1% 5E11	4822 116 52999
R 4838	MR25 1% 100E	5322 116 55549
R 4839	MR25 1% 100E	5322 116 55549
R 4841	MR25 1% 10K	4822 116 51253
R 4901	MR25 1% 1E	4822 116 52167
R 4902	MR25 1% 1E	4822 116 52167
R 4903	MR25 1% 1E	4822 116 52167
R 4904	MR25 1% 1E	4822 116 52167
R 4907	MR25 1% 1E	4822 116 52167
R 4908	MR25 1% 1E	4822 116 52167
R 4909	MR25 1% 1E	4822 116 52167
R 4911	MR25 1% 1E	4822 116 52167
R 4950	MR25 1% 1E	4822 116 52167
R 4951	MR25 1% 1E	4822 116 52167
R 4952	MR25 1% 1E	4822 116 52167
R 5001	PP17 20% 10K	5322 101 30546
R 5002	PP17 20% 10K	5322 101 30547
R 5003	PP17 20% 10K	5322 101 30546
R 5004	PP17 20% 10K	5322 101 30546
R 6000	MR25 1% 10E	5322 116 50452
R 6001	1.7A 20% 82E	4822 116 30069
R 6002	MR25 1% 215K	5322 116 54728
R 6003	MR25 1% 215K	5322 116 54728
R 6004	MR25 1% 100E	5322 116 55549
R 6005	MR25 1% 464E	5322 116 50536
R 6006	MR25 1% 10K	4822 116 51253
R 6007	MR25 1% 10K	4822 116 51253
R 6008	MR25 1% 316E	5322 116 54511
R 6009	0.5W 10% 1K5	4822 116 30248
R 6010	MR25 1% 14K7	5322 116 54632
R 6011	MR25 1% 215E	5322 116 55274
R 6012	MR25 1% 215E	5322 116 55274
R 6013	MR25 1% 100E	5322 116 55549
R 6014	MR25 1% 1E	4822 116 52167
R 6016	MR25 1% 681E	4822 116 51233
R 6017	MR25 1% 1E	4822 116 52167
R 6018	MR25 1% 1E	4822 116 52167
R 6031	MR25 1% 3K83	5322 116 54589
R 6032	0.25% 56K2	5322 116 53402
R 6033	0.25% 75K	5322 116 53403

POSNR	DESCRIPTION	ORDERING CODE
R 6034	MR25 1% 9E09	5322 116 53516
R 6036	MR25 1% 11E	4822 116 52909
R 6037	MR25 1% 750K	5322 116 55532
R 6037	MR25 1% 681K	5322 116 55284
R 6038	MR25 1% 100E	5322 116 55549
R 6041	MR25 1% 3K83	5322 116 54589
R 6042	MR25 1% 3K83	5322 116 54589
R 6043	MR25 1% 100K	4822 116 51268
R 6044	MR25 1% 100K	4822 116 51268
R 6103	MR25 1% 1K	4822 116 51235
R 6131	MR25 1% 10E	5322 116 50452
R 6132	MR25 1% 100K	4822 116 51268
R 6133	MR25 1% 100K	4822 116 51268
R 6134	MR25 1% 1K	4822 116 51235
R 6136	MR25 1% 4K64	5322 116 50484
R 6137	MR25 1% 316E	5322 116 54511
R 6138	MR25 1% 1K	4822 116 51235
R 6139	MR25 1% 100E	5322 116 55549
R 6201	0.25% 160K	5322 116 53412
R 6202	VR37 1% 31M6	5322 116 64103
R 6203	MR25 1% 316K	5322 116 55268
R 6204	MR25 1% 10K	4822 116 51253
R 6206	MR25 1% 16K2	5322 116 55361
R 6207	MR25 1% 51E1	5322 116 53213
R 6208	MR25 1% 464E	5322 116 50536
R 6209	MR25 1% 4K64	5322 116 50484
R 6211	MR25 1% 46K4	5322 116 50557
R 6212	MR25 1% 4K64	5322 116 50484
R 6213	MR25 1% 215E	5322 116 55274
R 6214	VR25 5% 10M	4822 110 72214
R 6216	MR25 1% 100E	5322 116 55549
R 6217	MR25 1% 1E	4822 116 52167
R 6300	MR25 1% 2K61	5322 116 50671
R 6301	MR25 1% 464E	5322 116 50536
R 6302	MR25 1% 909E	5322 116 55278
R 6303	MR25 1% 3K83	5322 116 54589
R 6304	MR25 1% 6K81	4822 116 51252
R 6311	MR25 1% 750E	4822 116 51234
R 6312	MR25 1% 4K22	5322 116 50729
R 6313	MR25 1% 1K1	4822 116 51236
R 6401	MR25 1% 1K78	5322 116 50515
R 6402	MR25 1% 178K	5322 116 54721
R 6403	MR25 1% 215E	5322 116 55274
R 6404	MR25 1% 6K81	4822 116 51252
R 6406	MR25 1% 26K1	5322 116 54651
R 6407	MR25 1% 3K48	5322 116 55367
R 6408	MTP10 20% 10K	5322 101 14066
R 6500	MR25 1% 10E	5322 116 50452
R 6501	MR25 1% 511E	4822 116 51282
R 6502	MR25 1% 100K	4822 116 51268
R 6503	MR25 1% 5K11	5322 116 54595
R 6504	MR25 1% 19K6	5322 116 54641
R 6506	MR25 1% 5K62	4822 116 51281
R 6507	MR25 1% 511E	4822 116 51282
R 6508	0.25% 3K67	5322 116 53411
R 6509	0.25% 500E	5322 116 53408
R 6511	MR25 1% 562E	4822 116 51231
R 7005	PP17 20% 10K	5322 101 30546
R 7006	PP17 20% 10K	5322 101 30546
R 7007	PP17 20% 10K	5322 101 30546

POSNR	DESCRIPTION	ORDERING CODE
R 7008	PP17 20% 10K	5322 101 30546
R 7009	PP17 20% 10K	5322 101 30546
R 7010	PP17 20% 10K	5322 101 30546
R 7011	PP17 20% 10K	5322 101 30546
R 7012	PP17 20% 10K	5322 101 30546
R 7013	PP17 20% 10K	5322 101 30546
R 7014	PP17 20% 10K	5322 101 30546
R 7021	MR25 1% 11K	5322 116 54623
R 7022	MR25 1% 10K	4822 116 51253
R 7023	MR25 1% 90K9	5322 116 54694
R 7024	MR25 1% 1K	4822 116 51235
R 7025	MR25 1% 1K	4822 116 51235
R 7026	MR25 1% 4K64	5322 116 50484
R 7027	MR25 1% 3K83	5322 116 54589
R 7028	MR25 1% 3K83	5322 116 54589
R 7029	MR25 1% 1K	4822 116 51235
R 7031	MR25 1% 1K	4822 116 51235
R 7032	MR25 1% 75K	4822 116 51267
R 7033	MR25 1% 5K11	5322 116 54595
R 7034	MR25 1% 162E	5322 116 50417
R 7036	0.5W 10% 2K2	4822 116 30254
R 7037	MR25 1% 1K1	4822 116 51236
R 7038	MR25 1% 1M	5322 116 55535
R 7041	MR25 1% 10K	4822 116 51253
R 7042	MR25 1% 10K	4822 116 51253
R 7102	MR25 1% 100E	5322 116 55549
R 8001	MR25 1% 10K	4822 116 51253

16.4.3 Semi-conductors

V 1000	BA483	4822 130 32656
V 1001	BF324	4822 130 41448
CRT D14-372GH/123		5322 131 20169
CRT D14-372GM/123		5322 131 20171
V 1002	BF324	4822 130 41448
V 1003	BF410C	4822 130 41482
V 1004	BA483	4822 130 32656
V 1005	BA483	4822 130 32656
V 1006	BF410C	4822 130 41482
V 1007	BA483	4822 130 32656
V 1008	BA483	4822 130 32656
V 1009	BA483	4822 130 32656
V 1010	BZX79-C8V2	4822 130 34382
V 1011	BF410C	4822 130 41482
V 1012	BA483	4822 130 32656
V 1013	BA483	4822 130 32656
V 1014	BA483	4822 130 32656
V 1016	BF410C	4822 130 41482
V 1017	BA483	4822 130 32656
V 1019	BF199	4822 130 44154
V 1021	BF199	4822 130 44154
V 1022	BF324	4822 130 41448
V 1023	BZX79-C5V6	4822 130 34173
V 1024	BF370	4822 130 42589
V 1061	BAW62	4822 130 30613
V 1062	BAW62	4822 130 30613
V 1063	BF324	4822 130 41448
V 1064	BF324	4822 130 41448
V 1100	BA483	4822 130 32656
V 1101	BF324	4822 130 41448
V 1102	BF324	4822 130 41448
V 1103	BF410C	4822 130 41482
V 1104	BA483	4822 130 32656
V 1105	BA483	4822 130 32656

POSNR	DESCRIPTION	ORDERING CODE
V 1106	BF410C	4822 130 41482
V 1107	BA483	4822 130 32656
V 1108	BA483	4822 130 32656
V 1109	BA483	4822 130 32656
V 1110	BZX79-C8V2	4822 130 34382
V 1111	BF410C	4822 130 41482
V 1112	BA483	4822 130 32656
V 1113	BA483	4822 130 32656
V 1114	BA483	4822 130 32656
V 1116	BF410C	4822 130 41482
V 1117	BA483	4822 130 32656
V 1119	BF199	4822 130 44154
V 1121	BF199	4822 130 44154
V 1122	BF324	4822 130 41448
V 1123	BZX79-C5V6	4822 130 34173
V 1124	BF370	4822 130 42589
V 1161	BAW62	4822 130 30613
V 1162	BAW62	4822 130 30613
V 1163	BF324	4822 130 41448
V 1164	BF324	4822 130 41448
V 1201	BF410C	4822 130 41482
V 1202	BA483	4822 130 32656
V 1203	BA483	4822 130 32656
V 1204	BF199	4822 130 44154
V 1205	BZX79-C8V2	4822 130 34382
V 1206	BF199	4822 130 44154
V 1207	BF324	4822 130 41448
V 1208	BZX79-C5V6	4822 130 34173
V 1209	BF199	4822 130 44154
V 1211	BF324	4822 130 41448
V 1212	BF324	4822 130 41448
V 1213	BF324	4822 130 41448
V 2001	BZV46-C2V0	4822 130 31248
V 2002	BZV46-C2V0	4822 130 31248
V 2003	BZX79-C3V0	4822 130 31881
V 2101	BZV46-C2V0	4822 130 31248
V 2102	BZV46-C2V0	4822 130 31248
V 2103	BZX79-C3V0	4822 130 31881
V 2305	BZV46-C1V5	5322 130 34865
V 2306	BZV46-C1V5	5322 130 34865
V 2308	BZX79-C4V3	4822 130 31554
V 2309	BZX79-C4V3	4822 130 31554
V 2310	BC558B	4822 130 44197
V 2311	BC558B	4822 130 44197
V 2313	BAW62	4822 130 30613
V 2314	BC558B	4822 130 44197
V 2315	BAW62	4822 130 30613
V 2316	BF324	4822 130 41448
V 2317	BC548C	4822 130 44196
V 2318	BF324	4822 130 41448
V 2319	BF324	4822 130 41448
V 2321	BF324	4822 130 41448
V 2325	BAW62	4822 130 30613
V 2326	BAW62	4822 130 30613
V 2327	BC558B	4822 130 44197
V 2328	BZX79-C5V1	4822 130 34233
V 2329	BZX79-C5V1	4822 130 34233
V 2331	BC558B	4822 130 44197
V 2332	BC558B	4822 130 44197
V 2333	BC558B	4822 130 44197
V 2334	BC558B	4822 130 44197
V 2341	BF199	4822 130 44154
V 2342	BF199	4822 130 44154
V 2347	BF199	4822 130 44154
V 2349	BF199	4822 130 44154

POSNR	DESCRIPTION	ORDERING CODE
V 2356	BC548C	4822 130 44196
V 2357	BC548C	4822 130 44196
V 2366	BAW62	4822 130 30613
V 2367	BAW62	4822 130 30613
V 2368	BAW62	4822 130 30613
V 2369	BAW62	4822 130 30613
V 2370	BC548C	4822 130 44196
V 2371	BC558B	4822 130 44197
V 2507	BAW62	4822 130 30613
V 2508	BAW62	4822 130 30613
V 2509	BC558B	4822 130 44197
V 2510	BC558B	4822 130 44197
V 2511	BC548C	4822 130 44196
V 2512	BF324	4822 130 41448
V 2513	BF324	4822 130 41448
V 2514	BF324	4822 130 41448
V 2516	BF324	4822 130 41448
V 2601	BZX79-C5V6	4822 130 34173
V 2602	BC548C	4822 130 44196
V 2611	BF199	4822 130 44154
V 2612	BF199	4822 130 44154
V 2615	BC548C	4822 130 44196
V 2616	BZV46-C1V5	5322 130 34865
V 3001	BF324	4822 130 41448
V 3002	BF324	4822 130 41448
V 3003	BC558B	4822 130 44197
V 3004	BF324	4822 130 41448
V 3006	BF324	4822 130 41448
V 3007	BC548C	4822 130 44196
V 3008	BF370	4822 130 42589
V 3009	BF370	4822 130 42589
V 3011	2N3866-01	5322 130 41799
V 3012	2N3866-01	5322 130 41799
V 3013	BZX79-C27	4822 130 34379
V 3014	BZX79-C27	4822 130 34379
V 3101	BF324	4822 130 41448
V 3102	BF324	4822 130 41448
V 3103	BF324	4822 130 41448
V 3104	BC558B	4822 130 44197
V 3106	BF324	4822 130 41448
V 3109	BF370	4822 130 42589
V 3111	BF370	4822 130 42589
V 3112	2N5551	5322 130 44491
V 3113	BZX79-C6V2	4822 130 34167
V 3114	2N5551	5322 130 44491
V 3116	2N5401	5322 130 41891
V 3200	BF370	4822 130 42589
V 3201	BF370	4822 130 42589
V 3202	2N5401	5322 130 41891
V 3203	2N5551	5322 130 44491
V 3204	BF423	4822 130 41646
V 3205	BZX79-B5V1	4822 130 34233
V 3206	BAW62	4822 130 30613
V 3207	BC548C	4822 130 44196
V 3208	BF423	4822 130 41646
V 3209	BAW62	4822 130 30613
V 3211	BAW62	4822 130 30613
V 3212	BZX79-C68	4822 130 30864
V 3213	BC548C	4822 130 44196
V 3214	BAW62	4822 130 30613
V 3215	BAW62	4822 130 30613
V 3216	BZX79-C12	4822 130 34197
V 3217	BAW62	4822 130 30613
V 3251	BF423	4822 130 41646
V 3252	BZX79-C6V2	4822 130 34167

POSNR	DESCRIPTION	ORDERING CODE
V 3253	BF423	4822 130 41646
V 3254	BF423	4822 130 41646
V 3256	BF423	4822 130 41646
V 3301	BZX79-C6V2	4822 130 34167
V 4001	BF199	4822 130 44154
V 4002	BF199	4822 130 44154
V 4003	BF199	4822 130 44154
V 4004	BC548C	4822 130 44196
V 4005	BC558B	4822 130 44197
V 4006	BF199	4822 130 44154
V 4007	BAW62	4822 130 30613
V 4008	BAW62	4822 130 30613
V 4009	BC548C	4822 130 44196
V 4011	BZX79-C5V1	4822 130 34233
V 4012	BC548C	4822 130 44196
V 4013	BZX79-C3V6	5322 130 34834
V 4014	BAW62	4822 130 30613
V 4016	BC548C	4822 130 44196
V 4017	BC548C	4822 130 44196
V 4018	BC548C	4822 130 44196
V 4031	BF199	4822 130 44154
V 4032	BF199	4822 130 44154
V 4033	BF199	4822 130 44154
V 4034	BC548C	4822 130 44196
V 4036	BF199	4822 130 44154
V 4037	BAW62	4822 130 30613
V 4038	BC548C	4822 130 44196
V 4039	BC548C	4822 130 44196
V 4041	BC548C	4822 130 44196
V 4101	BC558B	4822 130 44197
V 4102	BAW62	4822 130 30613
V 4103	BAW62	4822 130 30613
V 4104	BC548C	4822 130 44196
V 4106	BAW62	4822 130 30613
V 4107	BC327	4822 130 40854
V 4108	BC548C	4822 130 44196
V 4109	BC558B	4822 130 44197
V 4111	BC558B	4822 130 44197
V 4112	BSX20	4822 130 41705
V 4113	BAW62	4822 130 30613
V 4114	BSX20	4822 130 41705
V 4115	BZX79-C6V2	4822 130 34167
V 4116	BAW62	4822 130 30613
V 4117	BC548C	4822 130 44196
V 4118	BC548C	4822 130 44196
V 4119	BF199	4822 130 44154
V 4121	BC548C	4822 130 44196
V 4122	BAW62	4822 130 30613
V 4123	BAW62	4822 130 30613
V 4209	BC558B	4822 130 44197
V 4211	BC558B	4822 130 44197
V 4212	BSX20	4822 130 41705
V 4213	BAW62	4822 130 30613
V 4214	BSX20	4822 130 41705
V 4215	BZX79-C6V2	4822 130 34167
V 4216	BAW62	4822 130 30613
V 4217	BC548C	4822 130 44196
V 4218	BC548C	4822 130 44196
V 4219	BF199	4822 130 44154
V 4301	BAW62	4822 130 30613
V 4302	BC548C	4822 130 44196
V 4303	BC558B	4822 130 44197
V 4304	BC548C	4822 130 44196
V 4306	BAW62	4822 130 30613
V 4307	BC548C	4822 130 44196

POSNR	DESCRIPTION	ORDERING CODE
V 4308	BZV46-C1V5	5322 130 34865
V 4309	BC548C	4822 130 44196
V 4321	BAW62	4822 130 30613
V 4322	BC548C	4822 130 44196
V 4323	BC548C	4822 130 44196
V 4400	BZV46-C1V5	5322 130 34865
V 4401	BF324	4822 130 41448
V 4402	BZX79-C6V2	4822 130 34167
V 4500	BAW62	4822 130 30613
V 4501	BC548C	4822 130 44196
V 4502	BC548C	4822 130 44196
V 4503	BC548C	4822 130 44196
V 4504	BC548C	4822 130 44196
V 4505	BAW62	4822 130 30613
V 4506	BC548C	4822 130 44196
V 4510	BC558B	4822 130 44197
V 4511	BC558B	4822 130 44197
V 4512	BC558B	4822 130 44197
V 4513	BC558B	4822 130 44197
V 4514	BC558B	4822 130 44197
V 4516	BAW62	4822 130 30613
V 4517	BAW62	4822 130 30613
V 4518	BAW62	4822 130 30613
V 4519	BAW62	4822 130 30613
V 4521	BAW62	4822 130 30613
V 4522	BAW62	4822 130 30613
V 4523	BC548C	4822 130 44196
V 4601	BAW62	4822 130 30613
V 4602	BAW62	4822 130 30613
V 4611	BF199	4822 130 44154
V 4612	BF199	4822 130 44154
V 4613	BAW62	4822 130 30613
V 4614	BAW62	4822 130 30613
V 4616	BC548C	4822 130 44196
V 4702	BF324	4822 130 41448
V 4703	BAW62	4822 130 30613
V 4704	BAW62	4822 130 30613
V 4706	BF324	4822 130 41448
V 4707	BC558B	4822 130 44197
V 4708	BF324	4822 130 41448
V 4709	BC558B	4822 130 44197
V 4710	BC548C	4822 130 44196
V 4711	BAW62	4822 130 30613
V 4712	BF324	4822 130 41448
V 4713	BAW62	4822 130 30613
V 4801	BZV46-C1V5	5322 130 34865
V 4806	BAX12A	5322 130 34605
V 4807	BAX12A	5322 130 34605
V 4808	BAX12A	5322 130 34605
V 4809	BAX12A	5322 130 34605
V 6001	BYW56	5322 130 34973
V 6002	BYW56	5322 130 34973
V 6003	BYW56	5322 130 34973
V 6004	BYW56	5322 130 34973
V 6006	BAX12	5322 130 34605
V 6007	BAX12	5322 130 34605
V 6008	BAX12	5322 130 34605
V 6009	BC337	4822 130 40855
V 6011	BAX12	5322 130 34605
V 6012	BZX79-C15	4822 130 34281
V 6013	BRY39	5322 130 40482
V 6014	BUZ80	5322 130 43926
V 6016	BYV27-150	4822 130 31628
V 6017	BYV27-150	4822 130 31628
V 6018	BUT11	4822 130 42229

POSNR	DESCRIPTION	ORDERING CODE
V 6019	BYV26C	4822 130 32343
V 6031	BZX79-C3V6	5322 130 34834
V 6100	BYV19-45	5322 130 32703
V 6101	BYV19-45	5322 130 32703
V 6102	BYV95C	4822 130 41487
V 6103	BYV95C	4822 130 41487
V 6104	BYV27-150	4822 130 31628
V 6106	BYV27-150	4822 130 31628
V 6107	BYV95C	4822 130 41487
V 6108	BYV27-150	4822 130 31628
V 6109	BYV95C	4822 130 41487
V 6110	BYV27-150	4822 130 31628
V 6112	BT151-500R	5322 130 24081
V 6113	BYV95C	4822 130 41487
V 6132	BAX12	5322 130 34605
V 6132	BAW62	4822 130 30613
V 6133	BZX79-C6V2	4822 130 34167
V 6134	BC337	4822 130 40855
V 6136	BF423	4822 130 41646
V 6137	BF423	4822 130 41646
V 6138	BZX79-C5V6	4822 130 34173
V 6201	BC327	4822 130 40854
V 6202	BZX79-C15	4822 130 34281
V 6203	BAV21	4822 130 30842
V 6204	BAV21	4822 130 30842
V 6206	BAV21	4822 130 30842
V 6207	BYV27-150	4822 130 31628
V 6208	BUV26A	5322 130 42722
V 6209	BY509	4822 130 41485
V 6211	BC337	4822 130 40855
V 6301	BC548C	4822 130 44196
V 6302	BC558B	4822 130 44197
V 6303	BC337	4822 130 40855
V 6304	BC327	4822 130 40854
V 6311	BC337	4822 130 40855
V 6312	BDX78	5322 130 44278
V 6401	BZV11	5322 130 34294
V 6402	BAX12	5322 130 34605
V 6403	BC337	4822 130 40855
V 7001	BAW62	4822 130 30613
V 7002	BC548C	4822 130 44196
V 7101	BAW62	4822 130 30613

16.4.6 Miscellaneous

POSNR	DESCRIPTION	ORDERING CODE
E 0001	T13/4 28V 80MA	5322 134 40534
E 8001	A-1311 14V 80MA	5322 134 40727
G 7001	KYO	5322 242 71444
H 6000	CNX35 PEL	5322 130 90137
K 1001	12V.	5322 280 20125
K 1001	REED CONTACT	5322 280 24126
K 1002	12V.	5322 280 20125
K 1002	REED CONTACT	5322 280 24126
K 1003	12V.	5322 280 20125
K 1003	REED CONTACT	5322 280 24126
K 1004	12V.	5322 280 20125
K 1004	REED CONTACT	5322 280 24126
K 1006	12V.	5322 280 20125
K 1006	REED CONTACT	5322 280 24126
K 1007	12V.	5322 280 20125
K 1007	REED CONTACT	5322 280 24126
K 1008	12V.	5322 280 20125
K 1008	REED CONTACT	5322 280 24126
K 1101	12V.	5322 280 20125
K 1101	REED CONTACT	5322 280 24126
K 1102	12V.	5322 280 20125
K 1102	REED CONTACT	5322 280 24126
K 1103	12V.	5322 280 20125
K 1103	REED CONTACT	5322 280 24126
K 1104	12V.	5322 280 20125
K 1104	REED CONTACT	5322 280 24126
K 1106	12V.	5322 280 20125
K 1106	REED CONTACT	5322 280 24126
K 1107	12V.	5322 280 20125
K 1107	REED CONTACT	5322 280 24126
K 1108	12V.	5322 280 20125
K 1108	REED CONTACT	5322 280 24126
K 1201	12V.	5322 280 20125
K 1201	REED CONTACT	5322 280 24126
K 4101	12V.	5322 280 20125
K 4101	REED CONTACT	5322 280 24126
K 4201	12V.	5322 280 20125
K 4201	REED CONTACT	5322 280 24126

16.4.6 Miscellaneous

POSNR	DESCRIPTION	ORDERING CODE
E 0001	T13/4 28V 80MA	5322 134 40534
E 8001	A-1311 14V 80MA	5322 134 40727
G 7001	KYO	5322 242 71444
H 6000	CNX35 PEL	5322 130 90137
K 1001	12V.	5322 280 20125
K 1001	REED CONTACT	5322 280 24126
K 1002	12V.	5322 280 20125
K 1002	REED CONTACT	5322 280 24126
K 1003	12V.	5322 280 20125
K 1003	REED CONTACT	5322 280 24126
K 1004	12V.	5322 280 20125
K 1004	REED CONTACT	5322 280 24126
K 1006	12V.	5322 280 20125
K 1006	REED CONTACT	5322 280 24126
K 1007	12V.	5322 280 20125
K 1007	REED CONTACT	5322 280 24126
K 1008	12V.	5322 280 20125
K 1008	REED CONTACT	5322 280 24126
K 1101	12V.	5322 280 20125
K 1101	REED CONTACT	5322 280 24126
K 1102	12V.	5322 280 20125
K 1102	REED CONTACT	5322 280 24126
K 1103	12V.	5322 280 20125
K 1103	REED CONTACT	5322 280 24126
K 1104	12V.	5322 280 20125
K 1104	REED CONTACT	5322 280 24126
K 1106	12V.	5322 280 20125
K 1106	REED CONTACT	5322 280 24126
K 1107	12V.	5322 280 20125
K 1107	REED CONTACT	5322 280 24126
K 1108	12V.	5322 280 20125
K 1108	REED CONTACT	5322 280 24126
K 1201	12V.	5322 280 20125
K 1201	REED CONTACT	5322 280 24126
K 4101	12V.	5322 280 20125
K 4101	REED CONTACT	5322 280 24126
K 4201	12V.	5322 280 20125
K 4201	REED CONTACT	5322 280 24126

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